Ranking of Texas Reservoirs for Application of Carbon Dioxide Miscible Displacement

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1.0 Introduction

Injection of carbon dioxide (CO_2) into oil fields containing high-viscosity crude is one of the more successful enhanced oil recovery (EOR) techniques recently applied. CO_2 is injected into an oil field under high pressure to form a miscible bank of gases that decreases the viscosity of the oil. The process uses a concurrent, alternating, or subsequent injection of water to sweep the oil toward producing wells.

Active CO_2 miscible EOR projects have increased from just 17 in 1980 to 54 currently. Over the same period, EOR production from these projects has increased fivefold, from 21,532 to 161,486 barrels per day. Because of the existing infrastructure in the West Texas area, the number of miscible CO_2 enhanced oil recovery projects is expected to grow. The existing infrastructure makes the expansion of CO_2 into other nearby fields economically feasible.

Accompanying the rapid acceptance of the miscible CO_2 method by major oil and gas companies, a number of papers have been published in recent years that describe the properties exhibited by oil fields and reservoirs that make them amenable to the application of this technique. In 1992, Rivas et al., presented a paper at the Society of Petroleum Engineers (SPE) Latin-American Conference which proposed a method to rank reservoirs for the application of the CO_2 miscible EOR technique.[1] The ranking was based purely on technical merit and compared specific oil/reservoir systems to a set of optimum parameters. The parameters include API Gravity, oil saturation, reservoir pressure, temperature, the net oil column, reservoir dip, and porosity and permeability.

Under contract to the Department of Energy, Texaco commissioned the analysis described herein to determine the usefulness of CO_2 miscible flooding to oil fields in Texas. The analysis uses a methodology adapted by Louisiana State University from the paper published by Rivas et al., that automates the reservoir ranking process and adds an economic component. The report is intended to assist engineers with identifying candidate projects and to plan advanced recovery programs accordingly.

Many large oil companies have already developed their own screening criteria for evaluating and ranking producing properties. However, smaller companies do not have the resources or expertise to undertake such an evaluation and ranking. A major objective of this report is to generate interest among smaller and intermediate sized companies for using this EOR technique in their own fields. To this end, the report identifies fields that have a high probability of technical and economic success by applying a technical screen based on parameters from the Rivas paper and an economic screen based on a discounted cash flow analysis of each project. The report should also assist DOE staff to plan a proactive and targeted technology transfer campaign.

The technical screen developed by Rivas et al., showed that, on average the best reservoirs for carbon dioxide flooding should contain 36^0 API oil. The reservoir should also exhibit the following properties:

- a temperature of 150^0 F;
- a permeability of 300 md;
- an oil saturation of 60 percent;
- a reservoir pressure at the initiation of CO_2 injection about 200 psi greater than the minimum miscibility pressure;

- a porosity of 20 percent;
- a net sand thickness of 40 feet; and
- a reservoir dip of 20 degrees.

The technical screen was applied to the Texas reservoirs using the best and worst case parameter values specified in the paper by Rivas et al. An economic screen was then applied to the reservoirs remaining after the technical screen to identify projects that are economically as well as technically viable. The economic screen was based on a simple benefit/cost ratio computed using published field development costs and production potential for each project that passed the technical screen.

Of the 431 Texas reservoirs screened, 211 were found to be potentially profitable, with projected revenues exceeding costs. Only the top 154 reservoirs, however, showed a rate of return greater than 30 percent, while the top ten reservoirs predicted rates of return of at least 80 percent. Six of the top ten were Gulf Coast sandstone reservoirs.

1.1 Technical Approach

The ranking of the Texas oil reservoirs used an approach that was presented at the SPE Latin American Conference by Rivas et al., to screen Venezuelan heavy oil fields for the application of miscible CO_2-EOR techniques. This approach for ranking reservoirs was automated by Diaz at Louisiana State University and is the method used for this study.[2]

For this study, data on individual reservoirs were acquired for more than 400 large oil fields that currently account for more than 70 percent of annual Texas oil production. Almost half of the screened reservoirs are located in the Gulf of Mexico coastal region, in Texas Railroad Commission Districts one, two, three, and four. Reservoirs included in the study have produced on average about 10 million barrels each and have adequate geologic data available to perform the screening.

Piercement salt dome fields were excluded from the study because their complex structure, limited size, low well count, and high number make them significantly different from the reservoirs targeted for this study. Despite being beyond the scope of this study, it is recognized that these reservoirs also lend themselves to the application of the CO_2 enhanced recovery process.

Most of the physical data used in the technical screen are available for reservoirs in common units of measure. The minimum miscibility pressure (MMP), i.e., the lowest pressure at which about 95 percent of the contacted oil is recovered at a given temperature, is the exception. Oil and carbon dioxide are not generally directly miscible, but become so through the leaching of light hydrocarbons from the crude mixture. In other words the light hydrocarbons become gaseous. Reservoir temperature, oil composition, and carbon dioxide composition are all factors that determine MMP. Observable factors that can be used to determine MMP include:

1. MMP vs. temperature;
2. MMP vs. temperature and the molecular weight of C_{5+} (Pentanes and higher);
3. MMP vs. temperature and API gravity;
4. MMP vs. carbon dioxide density and C_{5+} composition;

5. MMP vs. detailed distribution of molecular size and structure;
6. MMP vs. API gravity, oil composition, and carbon dioxide purity.

Temperature and hydrocarbon distribution generally provide the most satisfactory predictions of MMP and are the most useful for initial estimates.

The remainder of the document is organized into the following sections:

Part 2.0 Field Application Review. Approximately 54 field/pilot projects are reviewed with major conclusions listed.

Part 3.0 Texas Reservoir Database. This data base was derived primarily from the hearings files of the Railroad Commission of Texas and is the one to which the technical and economic screens are applied.

Part 4.0 Screening Criteria. The technical screening model is described, sources of carbon dioxide by Texas County are presented, major assumptions are listed, and the results of the economic screen are discussed.

Part 5.0 Conclusions.

2.0 Field Applications Review

The Oil and Gas Journal reports that there are 54 active miscible carbon dioxide projects active in the United States, and this number is expected to grow.[3] Encouraging field results together with knowledge gained from ongoing projects have contributed to this growth. Recent innovations in miscible CO_2 recovery implemented by the oil industry are summarized by Diaz.[4] They describe intensive investment in infrastructure to develop and transport carbon dioxide to the main producing regions. The main region of CO_2-EOR application is currently the Permian Basin of New Mexico and West Texas, using carbon dioxide transported via pipeline from the McElmo Dome and Sheep Mountain Reservoirs in the Rockies and Bravo Dome in Mississippi. CO_2-EOR projects are also in progress in Mississippi and Louisiana, with CO_2 transported from the Jackson Dome (Mississippi). Oklahoma CO_2-EOR projects use CO_2 obtained from a fertilizer plant located in Enid, OK, while in the Texas Panhandle, CO_2 is supplied by the Labarge Gas Processing Facility operated by Exxon.

2.1 Miscible Field and Pilot Projects

A good compilation of information about projects involving displacement with carbon dioxide in sandstone reservoirs is provided in Hadlow, R.E., "Update of Industry Experience with CO_2 Injection" (1992); Goodrich, J. H., "Review and Analysis of Past and Ongoing Carbon Dioxide Injection Field Tests," (1980); Brock, W. R. and Bryan, L. A., "Summary Results of CO_2-EOR Field Tests, 1972-1987," (1989); and Mungan, N., "An Evaluation of Carbon Dioxide Flooding," (1991). To facilitate the analysis a comparison of several projects with all the information obtained from published sources is summarized in Table 2.1.1. The following conclusions were drawn from a close analysis of the information presented in Table 2.1.1.

- Miscible CO_2 injection is a reliable enhanced oil recovery method because numerous field tests have yielded considerable knowledge about the process. Process design parameters have been established and prediction techniques have been improved. Cost estimates are more reliable and CO_2 is more easily accessible than in the early years of the process. In addition, specialized equipment and techniques are now commercially available.

- Recovery results are encouraging, even though it is difficult to precisely quantify the expected final recovery due to the fact that many projects are still under development.

- Miscible CO_2-EOR has worked well in waterflooded and primary depleted reservoirs, and in reservoirs with wide ranges of original oil-in-place (OOIP). However, the remaining oil saturation in a reservoir must be high enough to justify the miscible displacement technique.

Table 2.1.1. Summary of Field and Pilot Applications of the Carbon Dioxide Miscible Displacement in Waterflooded Sandstone Reservoirs (Ref. 3,34-55)

Field	Operator	State	County	Start date	Area, acres	No. Wells Prod.	No. Wells Inj.	Pay Zone	Rock Type	Por %	Perm. Md	Depth feet	Grav. API	Visc. F	Temp F	Prev. Prod.	Proj. Matur.
DOCUMENTED FIELD OR RESERVOIR WIDE PROJECTS																	
Lost Soldier	Amoco	WY	Sweetwater	5/89	1345	47	52	Tensleep	Sand	9.9	31	5000	35.0	1.30	178	WF	HF
Wertz	Amoco	WY	Carbon, Sweetwater	10/86	1400	28	55	Tensleep	Sand	10.0	20	6000	35.0	1.16	163	WF	NC
North Ward Estes	Chevron	TX	Ward	3/89	3840	190	194	Yates	Sand	16.0	37	2600	36.0	1.40	83	WF	JS
Rangely Weber Sand	Chevron	CO	Rio Blanco	10/86	15000	204	200	Weber	Sand	12.0	10	6000	35.0	1.70	160	WF	JS
Ford Geraldine	Conoco	TX	Reeves & Culberson	2/81	3850	91	69	Deleware	Sand	23.0	64	2680	40.0	1.40	83	Prim/WF	HF
Twofreds	Enron O&G	TX	Loving, Ward, Reeves	1/74	4392	45	36	Delaware	Sand	19.5	32	4900	36.0	1.50	105	WF	NC
Northeast Purdy Unit	Oxy USA	OK	Garvin	9/82	8320	64	48	Springer	Sand	13.0	44	9400	38.0	1.20	148	WF	HF
Little Creek Field	Shell	MS	Lincoln & Pike	12/85	6200	26	18	Lower Tuscaloosa	Sand	23.0	33	10750	39.0	.040	248	WF	HF
Port Neches	Texaco	TX	Orange	7/93	235	6	5	Marginulina	Sand	30.0	750	5800	34.6	3.28	165	WF	JS
DOCUMENTED PILOT PROJECTS																	
Garber	Arco	OK	Garfield	10/81	38.3	9	4	Crews	Sand	17.0	57	1950	47.0	2.10	95	WF	Term
West Sussex Unit	Conoco	WY	Johnson	9/82	9.6	3	1	Shannon	Sand	19.5	28.5	3000	39.0	1.37	104	WF	Term
Quarantine Bay	Chevron	LA	Plaquemines	10/81	57	2	1	4 sand	Sand	26.4	0-1000	8120	32.0	0.99	183	Prim	NC
Rock Creek	Pennzoil	WV	Roane	10/76	20	2	6	Big Injun	Sand	21.7	19.3	2050	43.0	3.20	73	WF	HF
FIELD OR RESERVOIR WIDE PROJECTS																	
Sho-Vel-Tum	ARCO	OK	Stephens	9/82	1100	45	45	Sims	Sand	16.0	70	6200	30.0	3.30	115	WF	HF
Citronelle	Citronelle	AL	Mobile	5/84	1680	42	10	Rodessa	Sand	10-16	5-75	11000	42.0	46.00	210	Prim/WF	PP
Rose City North	George Brown	TX	Orange	1/83	900	8	5	Hackberry	Sand	37.0	4500	8200	37.0	2.00	180	WF	HF
Rose City North	George Brown	TX	Orange	1/83	900	8	5	Hackberry	Sand	37.0	4500	8200	37.0	2.00	180	WF	HF
Tinsley	Pennzoil	MS	Yazoo	11/81	1338	16	10	Perry	Sand	26.4	49	4800	39.0	1.50	175	WF	Term
Hansford Marmaton	Stanberry Oil	TX	Hansford	6/80	2010	9	10	Marmaton	Sand	18.1	48	6500	44.0	1.56	142	Prim	HF
Oliva	Shell	MS	Pike	10/87	1280	7	5	Lower Tuscaloosa	Sand	26.0	50	10500	39.0	0.34	250	WF	NC
Paradis	Texaco	LA	St. Charles	2/82	347	7	6	Lower 9000 ft	Sand	26.0	770	10400	37.0	0.50	205	Prim	HF
Paradis	Texaco	LA	St. Charles	1/88	44	1	1	9500 ft	Sand	24.0	252	9800	38.0	35.00	192	Prim	HF
Paradis	Texaco/MPV	LA	St. Charles	5/90	102	1	1	10000 ft	Sand	26.0	162	11400	38.5	0.30	192	Prim	HF
El Mar	Union Royalty	TX	Loving	4/94		7	7	Delaware	Sand	21.8	24	4500	40.5		97	Prim/WF	JS
PILOT PROJECTS																	
Kane	Pennzoil	PA	Elk	11/91	41	9	4	Kane	Sand	12.0	4	2500	48.0	2.50	80	WF	JS
Paradis	Texaco//MVP	LA	St. Charles	5/89	298	5	2	#16 sand	Sand	24.0	245	9950	38.0	35.00	190	Prim	HF

Table 2.1.1. Summary of Field and Pilot Applications of the Carbon Dioxide Miscible Displacement in Waterflooded Sandstone Reservoirs (Ref. 3,34-55) (Continued)

Field	So start %	So end %	Total Prod. b/d	Enh. Prod. b/d	Project Eval.	Profit	Project Scope	Ref.	OOIP MMBls	Swc %	Net Pay Feet	Space Acres/ Well	CO_2 Inj. Mmscf/ day	MMP psi	Gross Mscf/ bbl	Net Mscf/ bbl	CO_2 Source
Lost Soldier	45	36	7228	6464	Succ.	Yes	FW	3,34,35			28	10			13		Shute Creek Plant
Wertz	25	13	4699	2749	Succ.	Yes	FW	3,36	105.0		236	10	76.0	2350	15-19		Shute Creek Plant
North Ward Estes	25	10	2300	1200	Disc.		FW (Exp. UL)	3,37	1280.0	50	112	20	195.0	937	12	4.0	C02 Dome
Rangely Weber Sand	38	26	26000	16000	Succ.		FW	3,38,39	1578.0	28	250-300	20	170.0	3000	12-17	3-8	Shute Creek Plant
Ford Geraldine	41	35	1300	1300	Succ.	No	FW	3,40,41	83.0	35	25	40	20.0	900	10	6.0	Gas Plant, CO_2 domes
Twofreds	50		680	680	Succ.	Yes	FW	3,42-44	51.0	43	25	40	9.0	2330	12	9.6	Mivida gas plant
Northeast Purdy Unit	46	40	3200	2200	Succ.	Yes	RW	3,45-48	225.0	18	40	40	12.8	2100	7-10	4-6	Fertilizer plant
Little Creek Field	21	2	1320	1320	Prom.		FW	3,49-50	101.0	56	30	40	4.0	4500	27	13.0	
Port Neches	30	17	600	450	TETT		RW	3,51	12.5	20	30	40	4.3	3310			Industrial source
Garber	25-30	7-10	70	70	Succ.	No	P	3,52	0.6	30	21	10	1.8	1075	6.3		Fertilizer plant
West Sussex Unit	28	6	14	14	Prom.		P	3,53	0.2	27	22	10	0.8	1550	12.9		McCallum field
Quarantine Bay	38	15	125	125	Prom.	No	P	3,54	1.1	23	15	10	1.4	3480	2.57		New Orleans plant
Rock Creek	33	10	13	13	Succ.	No	P	3,30,55	0.7		31	10	0.8	1000	13	9.0	
Sho-Vel-Tum	59	42	2200	1800	Succ.	Yes	LW	3									
Citronelle	63		3300	350	Prom.		FW (Exp.L)	3									
Rose City North	50	35	500	500	Prom.		FW	3									
Rose City North	50	35	500	500	Prom.		FW	3									
Tinsley	65	38	150	150	Prom.	No	FW	3									
Hansford Marmaton	43		390	390	Succ.	Yes	FW	3									
Oliva	17	2	450	450	Succ.	Yes	FW	3									
Paradis	62	48	400	400	Prom.	No	RW	3									
Paradis	45	33	100	100	Prom.	No	RW	3									
Paradis	45	33	100	100	Prom.	No	RW	3									
El Mar	40.3	10	100	100			RW	3									
Kane	70	40	35	10	TETT		P	3									
Paradis	44	24	325	325	Prom.		P	3									

ABBREVIATIONS

Project Maturity

JS: Just started
HF: Half finished
NC: Near completion
C: Completed
PP: Postponed
Term: Terminated

Previous Production

Prim.: Primary
WF: Waterflooding

Project Evaluation

TETT: Too early to tell
Prom.: Promising
Succ.: Successful
Disc.: Discouraging

Project Scope

P: Pilot
FW: Field wide
LW: Lease wide
RW: Reservoir wide
Exp. UL: Expansion unlikely
Exp. L: Expansion likely

Table 2.1.1. Summary of Field and Pilot Applications of the Carbon Dioxide Miscible Displacement in Waterflooded Sandstone Reservoirs (Ref. 3,34-55) (Continued)

Field	Injection Pattern	CO_2 Injected HCPV	Oil Recov. % OOIP	CO_2 Injection Mechanism	Disposition Environment	Comments
Lost Soldier			10.0	WAG		Good areal, poor vertical efficiency
Wertz	5 spot	60	9-10	WAG 1:1 (1.5% ea.)	Eolian deposit	Dykstra Parsons, D.P. = 0.8, good areal efficiency
North Ward Estes	5 spot/line dr.	38	8.0	WAG 1:1 (2.5% ea.)	Tidal flat to lagunal	D.P. = 0.85, OGCap, Kv/Kh = 0.10
Rangely Weber Sand	5 spot	30	2-7	WAG 1:1 + water		Dip = 6/ 15-30 o, OGCap, Kv/Kh = 0.25- 0.50
Ford Geraldine	5 spot	30	13.0	C01 slug + brine	Deep water fan channel	Good vertical & poor areal sweep efficiecy
Twofreds	5 spot/line dr.	40	9.0	Slug + WAG + flue gas	Deep water fan channel	Dystra Parsons = 0.5
Northeast Purdy Unit	5 spot	30	7.5	Slug + WAG 3:1	Shallow marine	Dip = 8 o
Little Creek Field	1/4 of 9 spot			C02 slug		
Port Neches	5 spot		19.0	WAG		
Garber	5 spot	35	14.0	Slug + chase water	Deltaic & shallow marine	Lateral reservoir variation, dip ‹ 5 o
West Sussex Unit	Inv. 4 spot	30	7.8	Slug + chase water		Dip = 6 o
Quarantine Bay		18.9	16.9	WAG 1:1/2:1, 14 cycles	Inner deltaic	Dip = 4 o
Rock Creek	4 & 5 spot	48	11.0	Slug + chase water		OGCap, Kv/Kh = 0.79

- Recovery efficiencies range from 2 to 19 percent of OOIP, and the net amount of CO_2 required to recover an incremental barrel of oil varies from 3 to 13 thousand standard cubic feet (Mscf). The average recovery for documented cases is 10.8 percent of OOIP and the average CO_2 utilization ratio is 7.2 Mscf of carbon dioxide per incremental barrel of oil. These values agree fairly well with ones reported by Martin for application of CO_2 miscible displacement in different types of reservoir rock.[5]

- The most common well spacing is 40 acres per well, even though some applications--especially the pilot tests--had spacing of 10 acres per well. The preferred configuration was the 5-spot, sometimes combined with a line drive. The predominant injection mechanism was a 1:1 water alternating with CO_2, with innovations such as hybrid and tapered injection sometimes used. Injected CO_2 volumes varied between 19 and 60 percent of hydrocarbon pore volume (HCPV), with an average injection rate of 36 percent HCPV.

- Even though it was not possible to find complete information about the depositional environment of the reservoir rock, available data indicate reservoirs of diverse depositional environments, but all with relatively good continuity.

- Reported reservoir dips varied between 4 and 30 degrees, with a clear predominance of reservoirs with a low dip angle. Several of the reservoirs also had initial gas caps.

- The most common problems encountered during a project were surface and downhole equipment corrosion which was reported in 58 percent of the cases reviewed, followed by low vertical efficiency (50 percent of the cases), and asphaltene or paraffin precipitation (30 percent of the cases). It is also evident that the industry has gained a lot of experience dealing with these problems and had found ways to prevent or minimize them.

- Project profitability was not always reported, but about half of the reported cases were profitable. Obtaining CO_2 was usually responsible for a good portion of the project cost. Most of the reported sources of CO_2 were nearby industrial plants, which allowed for relatively easy transportation.

- Using the average estimated carbon dioxide utilization rate and an assumed cost of $0.70 per Mscf, the average recovery cost is about $5 per incremental barrel of oil.

- It is evident that in many of these projects, CO_2 injection rates were adjusted to maximize process efficiency. To do this, it was necessary to have good monitoring and maintenance programs so that the process performance could be assessed during the project life.

- More research is needed into methods for improving vertical sweep efficiency. Efficient vertical sweep requires a knowledge of reservoir geometry, and vertical and lateral geo-continuity and characteristics.

- From the point of view of field operations, many factors can be improved to reduce costs and therefore enhance project economics. These include: the optimized use of existing wells; injecting gels or polymers to improve areal sweep efficiency; injection of fluids at selected vertical intervals

in the well bore; reutilization of existing facilities; optimization of pressure build up in the reservoir; CO_2 recycling; and finally, application of technologies like horizontal drilling. Improvement in these factors could significantly increase the volumes of oil recovered and decrease the volume of CO_2 injected, therefore improving project profitability.

2.2 Texaco's Port Neches Field Test

In 1992, DOE and Texaco entered into a cooperative agreement to establish the viability of using miscible CO_2-EOR technology on Fluvial Dominated Deltaic (FDD) reservoirs, a large number of which are located along the Gulf Coast. This work was undertaken, in part, because primary and secondary recovery usually leaves more than 50 percent of the original oil in place behind. Texaco's project demonstrated the viability of the process in the Marginulina reservoir in the Port Neches field, Orange County, Texas. A by-product CO_2 source was used in the project and transported via pipeline from a nearby gas processing plant.

2.2.1 Relevance of the Technical Demonstration

The results of the demonstration project are expected to validate the use of a miscible CO_2 flood in other FDD reservoirs, particularly those reservoirs that have previously been waterflooded or that have a weak waterdrive, and provide a basis on which the decision to use the process in similar reservoirs can be made. Other petroleum operators will be able to predict the amount of incremental oil recovery that can be expected based on the experiences and results gained from this project. The project will demonstrate the impact of reservoir heterogeneities and the importance of reservoir characterization. The project will also provide a basis for estimating the applicability of the technology to highly heterogeneous clastic reservoirs other than FDD reservoirs. The project also demonstrated the effectiveness of a horizontal CO_2 injection well, noting the improvements in sweep efficiency of the residual oil column.

2.2.2 Encouraging Private Sector Implementation

The results in the Port Neches field will enable other oil and gas companies to assess the practicability and appropriateness of using CO_2-EOR in other reservoirs of this category. This technology is expected to have widespread applicability among other FDD reservoirs because it is common for these reservoirs to have relatively weak primary drive mechanisms and high remaining oil saturations after secondary recovery techniques, such as waterflooding, have been applied. Factors that could affect a company's decision to use this technology may include:

1. The incremental oil recovery expected by applying this process.

2. The availability and cost of CO_2, including transportation costs.

3. The costs of facilities, well workovers, drilling additional injection and/or producing wells, and incremental operating costs associated with the project.

4. The CO_2 recycle compression cost.

5. The overall project economics.

Based on the degree of success and profitability of the project, other petroleum operators that have similar reservoirs will be able to make intelligent decisions concerning the merit of using the CO_2-EOR.

3.0 Texas Reservoir Database

Appendix A provides a full description of the data elements in the Texas Reservoir Database developed for this project. Much of the information contained in the data base was derived from the hearings files of the Texas Railroad Commission. Commission data that proved particularly informative include unitization, injection, maximum efficient recovery, field rules, and date of discovery files. Additional sources of numerical and descriptive data include:

1. Oil and gas reservoir files compiled by the U.S. Department of Energy, Energy Information Agency, Dallas Field Office.

2. Compilations of field studies published by various regional geological societies, the American Association of Petroleum Geologists, and the Society of Petroleum Engineers.

3. Publications of the Texas Railroad Commission, including the 1981 Annual Report and a survey of secondary and enhanced recovery operations.

4. Publications by the Rand Corporation and the U.S. Department of Energy on major oil and gas fields in the United States and evaluations of fields targeted for enhanced recovery.

Data were supplemented with information provided by individual operating companies. All of the above sources are documented in the Bibliography at the end of this report.

The accuracy of publicly available quantitative reservoir data varies greatly. Different sources commonly gave different values for the same type of data. Where great discrepancies exist, data values were selected on the basis of known geologic criteria and within the context of the overall information available on a reservoir. Data were weighted in favor of records that reflected greater geological and engineering research efforts.

4.0 Screening Criteria

This section provides a description of the technical criteria used for the technical screen performed on the Texas Reservoir Database. It is followed by a section outlining the calculation of the cost of obtaining CO_2 and its likely sources. The economic screen is then described and assumptions and limitations of the study are discussed. Finally, the results of the technical and economic screen are presented.

4.1 Technical Criteria (Calculation of Technical Ranking Factor)

The Rivas study defined the optimum reservoir characteristics by performing numerical simulation on a base case to determine the value of a selected set of parameters which maximized oil recovery from the simulated CO_2 flood. The base case was assumed to be a 10-year injection program in a five-spot well configuration with 40 acre spacing. The optimum values for the parameters were determined by varying parameter values slightly around starting-values provided by Rivas. Few, if any, reservoirs would exactly match the parameter values of this ideal. The numerical simulation was performed using three off the shelf reservoir simulation models -- a fully compositional simulator, a black oil model, and a semi-analytical predictive model.

In ranking a set of randomly selected oil reservoirs, Rivas determined reservoir parameter values that represent the most extreme, but realistic departures from the optimum. These extreme parameters are combined to define the worst case reservoir. This worst case reservoir, in most cases, would not be one of the actual reservoirs being ranked, but rather would be a hypothetical reservoir and provides a boundary for parameter values. Reservoirs with parameter values which are "outside" the worst case were either eliminated from the analysis or their outlier parameters were assigned the worst case value.

As parameters were varied around their optimum, Rivas noted their effect on the variation in oil recovery. The shape of parameter performance curves suggested that some of the parameters may have more of an effect on performance than others. Parameters that produced a more acute effect on production were considered to be more important than those that have little effect. Rivas assigned weights to the parameters based on their relative effect on production. The most influential parameters were found to be API gravity, oil saturation, and reservoir pressure.

Table 4.1.1 presents the parameters which optimized process performance as given by the numerical simulations discussed above. It also provides the upper limit on the value of a parameter and shows the weight assigned by Rivas based on the relative influence of each parameter on production. Results from the three simulations for the most influential parameters are shown in Figures 4.1.1, 4.1.2, and 4.1.3 taken from Rivas.

Rivas assigned one technical ranking factor for each reservoir by calculating the weighted sum of all the reservoir property parameters. The technical ranking factor was then normalized so that the best reservoir has a factor of 100, and the worst reservoir has a factor of 0.

Table 4.1.1. Optimum Reservoir Parameters, Upper Limit, and Weighting Factors.[22]

Parameter	Optimum	Upper Limit	Weight
API Gravity, °API	37	54	0.24
Oil Saturation, %	60	83.1	0.20
Pressure/MMP	1.3	1.3	0.19
Temperature, °F	160	250	0.14
Net Oil Column, ft	50	300	0.11
Permeability, md	300	2500	0.07
Dip, degrees	20	20	0.03
Porosity, %	20	35	0.02

Source: Rivas, O., Embid, S., and Boliver, F. "Ranking Reservoirs for CO_2 Flooding Processes," SPE paper 23641 presented at the 1992 SPE Latin American Petroleum Engineering Conference, Caracas, March 8-11.

This method of ranking reservoirs was used to rank the reservoirs in the Texas Reservoir Database. Several reservoirs were first eliminated from the database because important data, e.g. API gravity, were either missing or questionable. The remaining reservoirs were then ranked using the technical screen procedure described above. Then, the economic screen was applied as described in Section 4.3. The economic screen is heavily dependent on sources and costs of obtaining CO_2 which are described in the next section (4.2).

Figure 4.1.1 Average Oil Production as a Percent of Oil Saturation

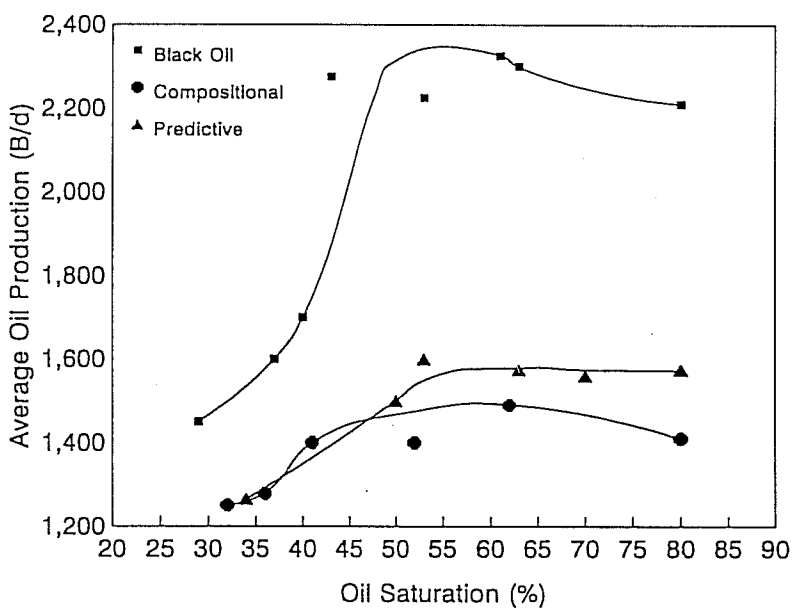


Figure 4.1.2 Average Oil Production as a Function of Pressure Ratio

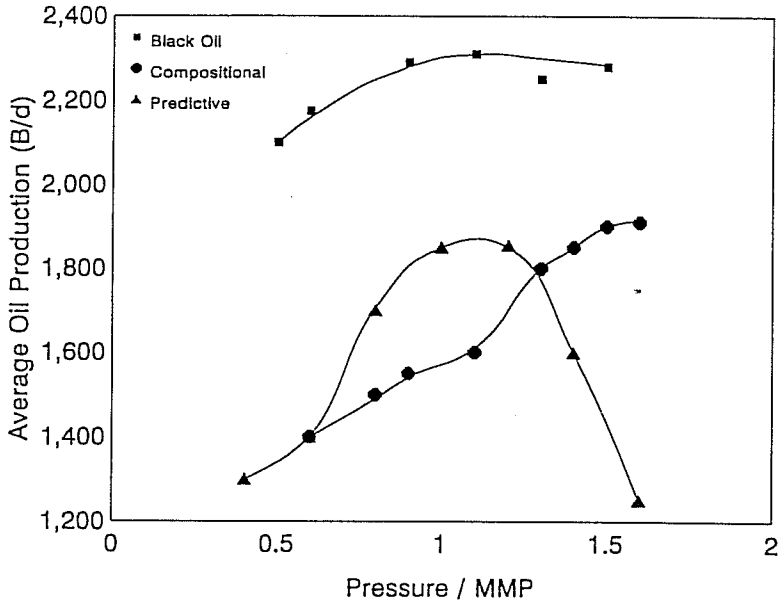
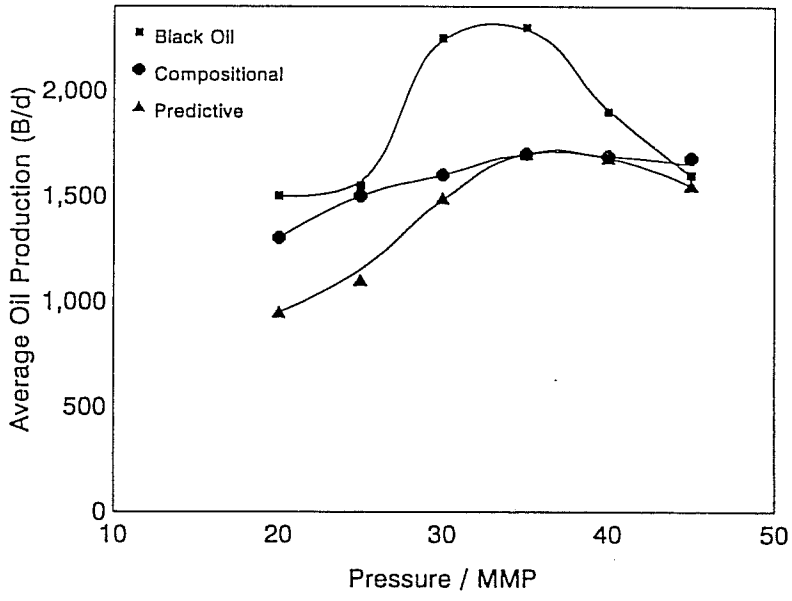


Figure 4.1.3 Average Oil Production as a Function of API Gravity



4.2 Sources of Carbon Dioxide and Cost

Sources of CO_2 were derived primarily from studies performed by Science Applications International Corporation (SAIC) for the Department of Energy, Morgantown Energy Technology Center (METC)[6]. It was assumed that only Permian Basin CO_2 demand would be supplied by naturally occurring CO_2. All other promising reservoirs, particularly those in the Gulf Coast region, have access to highly pure CO_2 produced as a by-product of local industry and natural gas processing plants (Figure 4.2.1).

Miscible CO_2-EOR technology has a history of success in the vast West Texas oil fields. However, recent efforts by Texaco, Shell, and others to emulate the West Texas successes on the Gulf Coast have so far proved inconclusive. There are three reasons for the inconclusive results:

1. There are significant differences between the reservoirs in West Texas and those along the Gulf Coast. West Texas CO_2-EOR projects are located primarily in carbonate reservoirs with limited faulting, whereas Gulf Coast reservoirs tend to be primarily clastic and highly faulted;

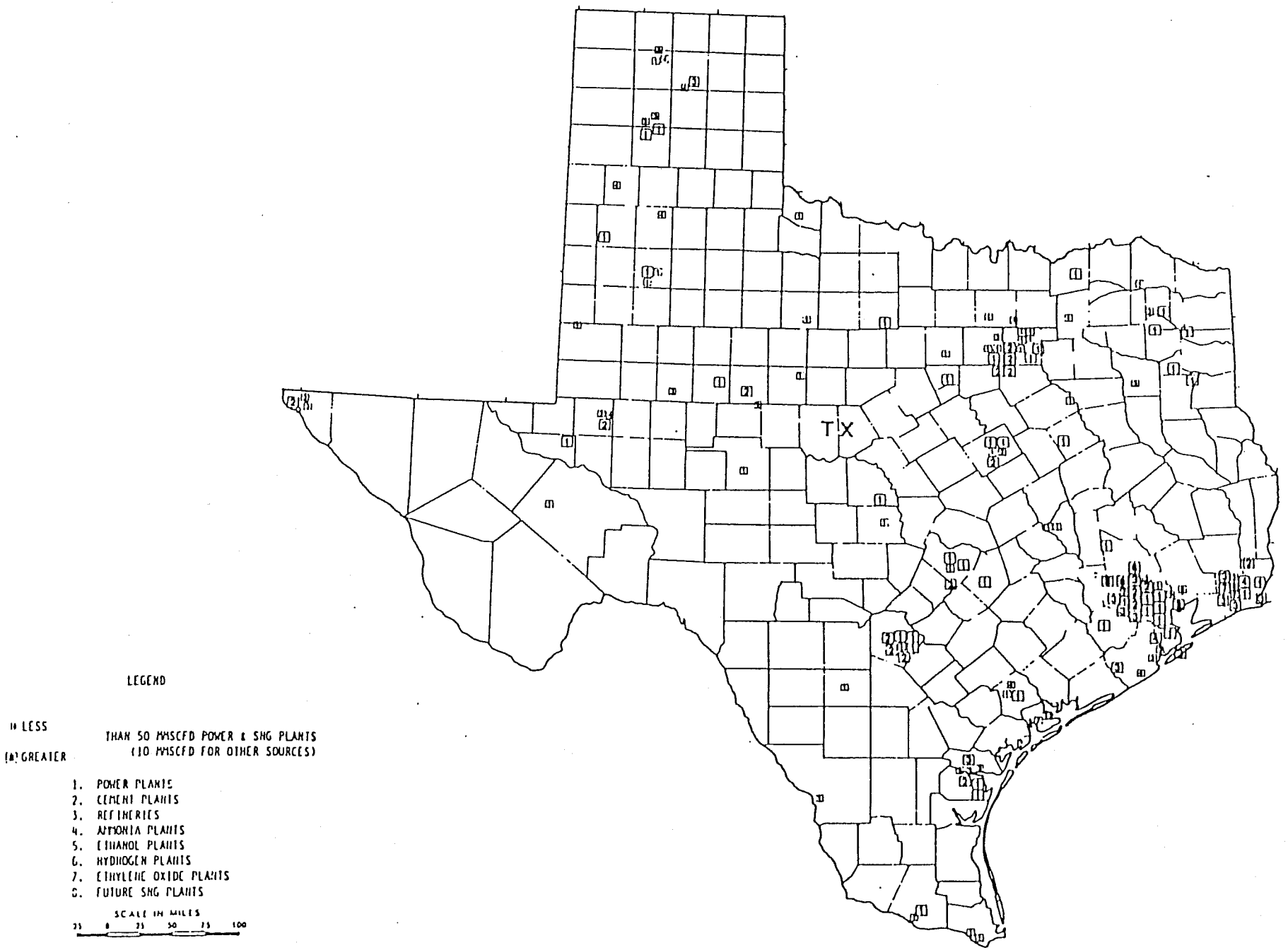
2. A plentiful CO_2 source and transportation network brings CO_2 to the West Texas fields, whereas the Gulf Coast lacks such a network; and

3. The contrast in the surface environment affects transportation, emission containment, and water disposal options and costs. These effects are shown in Table 4.2.1

Table 4.2.1 Comparative Features Affecting CO_2-EOR Design

	West Texas Features	Gulf Coast Features	Net Effect on Gulf Coast CO_2-EOR
Reservoir Type	Carbonate reservoirs with limited faulting.	Clastic and highly faulted.	Poor pattern design, limited success in forecasting oil recovery, CO_2 channeling, and higher recycle costs.
CO_2 Source	Large number of developed natural supply sources and integrated network.	One natural supply, a number of smaller by-product supplies, limited pipeline network.	May require developing the CO_2 source and building a pipeline network.
Surface Features	Minimally populated prairies with low annual rainfall.	Wetlands, timber-lands, and farm-land intermixed with high density areas with considerable rain-fall.	Pipelines more expensive in sensitive areas, water disposal requires consideration, air pollution may be a factor.

Figure 4.2.1. By-Product Sources of Carbon Dioxide in Texas



Impurities, such as nitrogen (N_2) hydrogen sulfide (H_2S), or methane (CH_4) are common in natural sources of CO_2, while nitrogen and carbon monoxide (CO) are common in manmade sources, such as flue gas. The presence of these impurities produces variations in CO_2 miscibility pressure and creates safety and production problems. Contamination by N_2, CO, and CH_4 increases miscibility pressure and therefore requires higher operating pressures. Although contamination by H_2S decreases miscibility pressure, this positive effect is more than offset by the additional fail-safe metering and more expensive and corrosion resistant higher carbon steel required to manage the H_2S. Project economics are substantially improved when a source of CO_2 with greater than 95 percent purity is used.

The pressure of CO_2 at its source is a critical factor in CO_2 transportation and injection costs. At pressures above 1,000 psi, CO_2 is a liquid and can be transported relatively cheaply using pumps or a natural pressure drop. Either option is cheaper than the alternative method of purchasing and operating gas compressors. In addition, to get CO_2 to the reservoir at a pressure above miscibility pressure generally requires injecting CO_2 above 1,000 psi. Raising the pressure from atmospheric pressure to 1,000 psi can cost $0.10 to $0.25 per Mscf, depending on capital equipment and energy costs.

The only industrial by-product sources that can potentially provide CO_2 for a delivered cost less than $2 per Mscf are power plants and highly pure sources from ammonia plants and catalytic cracking units. Sources of CO_2 in Texas, by county, are listed in Tables 4.2.2, 4.2.3, and 4.2.4. It is assumed that by-product sources of CO_2 will on average cost more than natural sources. Because CO_2 is a unique input variable, a miscible CO_2-EOR project which relies on an industrial by-product source is penalized with a 20 percent cost premium.

Pipelines are the most economical form of transport for large volumes of CO_2 over short and long distances (one to 20 miles and more than 150 miles). Truck transport is competitive with pipelines for small volumes (one to 10 MMscf per day) over medium distances. For pilot projects, either truck or rail may be the best method of transport, depending on the availability of transport system equipment, rail facilities, and the volumes of CO_2 required.

Table 4.2.2 Power Plants by County

County	Company, Plant, Unit	Capacity MW	Type of Fuel Coal © Oil (O) Gas (G)	Approx. CO_2 MMSCF/D	CO_2 Quality (% Vol)					
					CO_2	O_2	N_2	No_x	SO_2	N_2O
Houston Lighting & Power										
Fort Bend	Parish Unit 6	660	C	167	13.6	2.3	71.8	.39	.069	11.9
	Unit 7	600	C	152	13.6	2.3	71.8	.39	.069	11.9
	Unit 8	600	C	152	13.6	2.3	71.8	.39	.069	11.9
	Limestone Unit 1	750	C	190	13.6	2.3	71.8	.39	.069	11.9
	Unit 8	750	C	190	13.6	2.3	71.8	.39	.069	11.9
Texas Power & Light										
Rusk	Merlin Lake Unit 3	750	C	190	13.5	1.9	71.4	.42	.26	12.5
	Sandow	545	C	138	13.5	1.9	71.4	.42	.26	12.5
	Forest Grove Unit 1	750	C	189	13.5	1.9	71.4	.42	.26	12.5
	Twin Oak Unit 1	750	C	189	13.5	1.9	71 4	.42	.26	12.5
	Unit 2	750	C	189	13.5	1.9	71.4	.42	.26	12.5
	Unsited Unit 1	750	C	189	13.5	1.9	71.4	.42	.26	12.5
	Unit 2	750	C	189	13.5	1.9	71.4	.41	.26	12.5
	Unit 3	750	C	189	13.5	1.9	71.4	.41	.26	12.5
Lower Colorado River Authority										
Baylor	Seymour Unit 1	550	C	140	13.5	1.9	71.4	.41	.26	12.5
	Unit 2	550	C	101	13.5	1.9	71.4	.41	.26	12.5
	Unit 3	400	C	101	13.5	1.9	71.4	.41	.26	12.5
Southwestern Public Service										
	Celanese Unit 2	29	C	8	13.5	1.9	71.4	.41	.26	12.5

Table 4.2.2 Power Plants by County (Continued)

County	Company, Plant, Unit	Capacity MW	Type of Fuel Coal © Oil (O) Gas (G)	Approx. CO_2 MMSCF//D	CO_2 Quality (% Vol)					
					CO_2	O_2	N_2	NO_x	SO_2	H_2O
Brazos Electric Power Coop										
	San Miguel Unit 1	400	C	101	13.5	1.9	71.4	.41	.26	12.5
	Unit 2	400	C	101	13.5	1.9	71.4	.41	.26	12.5
Texas Power Pool										
	Gibbons Creek Unit 1	400	C	101	13.5	1.9	71.4	.41	.26	12.5
	Unsited Unit 1	400	C	101	13.5	1.9	71.4	.41	.26	12.5
	Unit 2	400	C	101	13.5	1.9	71.4	.41	.26	12.5
San Antonio Public Serv. Brd.										
	Unsited Unit 1	500	C	127	13.5	2.3	71.8	.39	.069	11.9
Harris	Wharton	322	C	56.5	9.1	1.7	72.1	-	-	17.0
Lower Colorado River Auth.										
Llano	Ferguson		C	45.9	9.1	1.7	72.1	-	-	17.0
Harris	Clarke	210	G	15.3	9.1	1.7	72.1	-	-	17.0
Harris	Clarke	210	G	15.3	9.1	1.7	72.1	-	-	17.0
Harris	Deepwater	353	G	45.9	9.1	1.7	72.1	-	-	17.0
Harris	Green Bayou	821	G	115.3	9.1	1.7	72.1	-	-	17.0
Fort Bend	Parish	2723	G	347.2 0.0 89.6	9.1	1.7	72.1	-	-	17.0
Galveston	Robinson	2314	G	432.0	9.1	1.7	72.1	-	-	17.0
Harris	Webster	614	G	96.5	9.1	1.7	72.1	-	-	17.0

Table 4.2.3 Ammonia Plants - by County

County City	Company	Ammonia Production Capacity Tons/Stream	CO_2 Generation Capacity Tons/Stream	CO_2 Recovered Tons/Stream Day	CO_2 Availability Tons/Stream	MMSCF/D
TEXAS Brazoria Freeport	Dow Chemicals	129	165	No Information Available		
Castro Dunnutt	Goodpasture, Inc.	189	205	96	109	1.9
Ector Odessa	El Paso Products Co.	330	392	4	388	6.6
Galveston Texas City	Amoco (Sub. Of Standard Oil of Ind.)	2,140	2,600	1,950	650	11.0
Hale Plainview	Hooker Chem. Co.	181	230	No Information Available		
Harris Deer Park	Rohn & Haas Co.	123	156	No Information Available		
Hutchinson Borger	Camex, Inc.	1,191	1,625	1,460	165	2.8
Jefferson Beaumont	E.I. DuPont de Nemours & Co.	1,034	1,400	350	50	18.0
Moore Dumas	Diamond Shamrock Corp.	400	510	26	74	8.1
Victoria Victoria	E.I. DuPont De Nemours & Co.	274	375	0	75	6.4

Table 4.2.4 List of Fluid Catalytic Cracking Units CO_2 Generation Capacity

County/City	Company	Capacity MBBLS/ Stream Day	CO_2 Generated MMSCF/D
Brazoria/Sweeney	Phillips Petroleum Co	42.2	8.7
Ector/Odessa	Shell Oil Co.	16.0	3.3
El Paso/El Paso	Chevron USA, Inc.	28.6	5.9
El Paso/El Paso	Texaco, Inc.	9.1	1.9
Galveston/Texas City	Amoco Oil Co.	217.0	44.5
Galveston/Texas City	Marathon Oil Co.	39.0	8.0
Galveston/Texas City	Texas City Refining Inc.	40.0	8.2
Harris/Baytown	Exxon Co. USA	185.0	37.9
Harris/Deer Park	Shell Oil Co.	91.0	10.7
Harris/Houston	Atlantic Richfield	83.0	17.5
Harris/Houston	Charter International Co.	62.4	10.0
Harris/Houston	Crown Central Petroleum Corp.	50.0	10.0
Howard/Borger	Phillips Petroleum Co.	62.4	12.0
Jefferson/Beaumont	Mobil Oil Corp.	123.0	25.0
Jefferson/Beaumont	Union Oil Co. Of California	42.0	8.0
Jefferson/Port Arthur	American Petro-Inc.	36.0	7.4
Jefferson/Port Arthur	Gulf Oil Co.	126.0	25.8
Jefferson/Port Arthur	Texaco, Inc.	175.5	36.0
Moore/Sunray	Diamond Shamrock Corp.	32.5	6.7
Nueces/Corpus Christi	Champlin Petroleum Co.	89.7	18.4
Nueces/Corpus Christi	Coastal States Petrochemical Co.	10.6	2.2
Nueces/Corpus Christi	Southwestern Refining Cl.	12.7	2.6
Nueces/Corpus Christi	Sun Cl.	31.5	6.5
Potter & Randall/Amarillo	Texaco, Inc.	10.4	2.1
Smith/Tyler	La Gloria Oil & Gas Co.	10.5	2.2
Tarrant/Fort Worth	Winston Refining Co.	6.0	1.2
Titus/Mt. Pleasant	Dorchester Refining Co.	12.0	2.5

4.3 Economic Screening Criteria

The economic screen is a simple discounted cash flow comparison of most of the reservoirs remaining after the technical screening. Economic screening and prioritization are based on the ratio of net revenue (profit) to cost. It was assumed, for the purpose of economic ranking that the technical ranking factor calculated with the technical screen provides a reasonable approximation of a potential oil recovery factor.

The potential oil recovery used in the economic screen is defined as the product of the original oil-in-place, the expected recovery factor for CO_2 flooding, and the technical ranking factor. Other parameters used in the economic screen are reservoir area, number of existing wells, depth, and distance to a CO_2 source. All capital and operating costs are calculated using equations shown in Table 4.3.1. Major assumptions for the screen are CO_2 price, oil price, well spacing, and expected recovery (fraction of OOIP).

Table 4.3.1 Economic Calculation Equations

Parameter	Definition
Gross Revenue	Gross Revenue = Recoverable oil * oil price. where, Recoverable oil = OOIP * Technical ranking factor * Recovery factor.

Capital cost
o Drilling[7,8]
o Equipment[9]
o CO_2 Pipeline[10,11]
 	
o Separation[12,13]
	
	New well cost = \$30,340 * # wells * $e^{(0.00035 * depth)}$
	Equipment = 8.3125 * depth * # wells
	Pipeline = [\$100,000 + (pipeline capacity$^{0.834}$)] * distance
	where,
	pipeline capacity = 6 * (Recoverable oil)
	
	Separation = Recoverable oil * 4 (Mscf/B) * \$0.25

Operating Costs	Well Operations = (1,040 + 0.1462 * depth) * 12 * # wells
CO_2 Cost[14,15,16,]	CO_2 Costs = Recoverable oil * 6 (Mscf/B) * price (\$/B)
Net Revenue	Net Revenue = (Gross Revenue - Total costs) * (1.0 - tax rate)
Profit/Cost Ratio	Profit/Costs = Net revenue/ Total Costs

Source: Equation sources are in parentheses and were extracted from papers listed in the references.

4.4 Assumptions and Limitations of the Screening

In order to rank the reservoirs, it is necessary to have a parameter that can be easily used for comparison of all of the possible reservoirs. Several assumptions based on engineering judgement supported by data and literature review, were made to maintain the manageability of the analysis.

- The maximum expected recovery from the miscible CO_2-EOR process is 10 percent of original oil in place. The review of the field and pilot applications suggests that this value is technically sound, if not on the conservative side. In this assumption, the kind of processes used for the displacement are not differentiated, and the same annual production profile is used for all reservoirs used in the discounted cash flow.

- The reservoirs possessing better properties for the process are assumed to perform better economically. The technical ranking factor obtained from the technical screening is used to determine the potential recovery factor (PR) that is used to predict reservoir performance.

- Parameter values used in the equations are from published investigations. If any of the parameter values are biased, they are applied to all reservoirs equally and should therefore not introduce bias to any specific reservoir.

- Dip was unknown in most cases and in fact is probably not constant for the largest reservoirs. The reservoirs for which dip was known averaged about 10 degrees, albeit with some extreme variation. For this analysis the dip was set at a constant 20 degrees for all reservoirs.

- Well spacing was assumed to be uniform and constant. Although the areal extent of each reservoir was generally not known, for the screen each reservoir was normalized to equal one five spot on a 40-acre spacing. It was further assumed that all five wells were already equipped and operational. The original oil in place in this normalized reservoir is calculated as the product of net pay, porosity, and oil saturation. Most reservoirs in this study are many times larger than this assumption and most wells would probably not be fully developed or would need to be drilled.

- Operating costs and CO_2 costs are reported on an annual basis and are assumed to be constant over the life of a project. The expected life of a project is assumed to be twenty years.

- The cost of using CO_2 from non-natural sources is assumed to be 20 percent more expensive than using naturally occurring CO_2.

4.5 Results of Technical and Economic Screening

The screening methods described above were used to screen the largest, most productive reservoirs in the State of Texas. Initially the database contained over 500 reservoirs. Over 100 reservoirs were initially eliminated due to a lack of geologic information, leaving 378 reservoirs with sufficient data for the technical screen.

Table 4.5.1 presents the ranking of the 211 reservoirs left after the economic screen was performed. There are two columns with rank numbers. The first column shows the results of the technical screen. The second column shows the result of the economic screen, ranked in order. The economic parameters used in the screen were: recovery factor - 10 percent; oil price - $17/bbl; taxes - 15 percent; CO_2 costs - $0.60 per Mscf.

The screens provide a very fast method of ranking many reservoirs, making sensitivity analysis on key parameters practical. The economic ranking, although simple, appeared to give valid results as most of the current CO_2 field applications that were contained in the database placed high in the rankings. That is, the projects that ranked high after the survey are already considered profitable by their operators.

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
KEYSTONE COLBY	38	87	3	54.87	0.95	13	900	10	99.70	200	5	3100	72.89	2.536
VAN WOODBINE	34	140	1000	75.66	0.36	29	250	10	85.18	200	5	2700	44.94	2.428
HASTINGS, W. FRIO	31	160	865	66.51	0.59	31	163	10	52.19	200	5	6100	57.64	2.244
ESPERSON DOME S. CROCKETT	39	200	240	63.18	0.9	27	176	10	46.63	200	5	7300	77.97	2.179
FAIRBANKS FAIRBANKS	36	185	2000	58.2	0.73	28	91	10	23.03	200	5	6800	81.68	2.036
WASSON	33	107	4	66.51	0.67	10	275	10	28.41	200	5	4900	55.35	1.993
HOWARD-GLASSCOCK PERM.	32	86	25	58.2	0.2	12	147	10	15.94	200	5	1500	56.91	1.990
SUGARLAND UPPER FRIO	29	149	900	59.86	0.33	29	85	10	22.91	200	5	3800	58.45	1.930
OYSTER BAYOU SEABREEZE	36	190	1325	66.51	0.89	29	150	10	44.93	200	5	8300	75.20	1.920
LIVINGSTON WILCOX	35	183	70	62.35	0.65	21	81	10	16.47	200	5	7400	78.44	1.787
SEMINOLE WEST	34	102	9	68.17	0.82	10	180	10	19.06	200	5	5100	59.28	1.774
LAKE PASTURE H-440 S	24	155	1197	56.53	0.32	32	75	10	21.07	200	5	4500	45.29	1.696
COWDEN NORTH	35	114	7	63.27	0.68	10	125	10	12.28	200	5	4300	71.33	1.675
WELLMAN	43	151	100	64.02	1.88	8	338	10	26.88	200	5	9300	73.34	1.633
WALNUT BEND REGULAR	36	115	176	62.35	0.94	19	50	10	9.2	200	5	4900	83.53	1.591
GOOD	44	140	52	53.21	1.94	8	246	10	16.26	200	5	8000	64.17	1.588
WADDELL	34	88	12	53.21	0.78	11	100	10	9.09	200	5	3500	65.57	1.499
UNIV. BLOCK 31 DEVONIAN	40	140	0.7	49.88	1.69	15	130	10	15.11	200	5	8500	75.70	1.484
SEMINOLE	35	108	25	73.33	0.81	13	87	10	12.88	200	5	5200	55.25	1.458
HAWKINS WOODBINE	24	168	3394	74.82	0.25	26	109	10	32.93	200	5	4500	21.30	1.449
TODD DEEP CRINOIDAL	41	163	14	67.34	1.01	12	115	10	14.43	200	5	5800	73.71	1.417
TODD DEEP ELL.	42	158	5	54.87	1.09	7	155	10	9.25	200	5	6000	76.58	1.390
WASSON 6600 AND 7200	33	118	10	63.18	0.71	8	135	10	10.6	200	5	6900	66.87	1.322
GOLDSMITH CLEAR FORK	40	110	5	62.35	1.37	12	70	10	8.13	200	5	6100	84.35	1.304
GOLDSMITH 5600	38	105	25	58.2	1.14	15	50	10	6.78	200	5	5600	87.58	1.262
ANAHUAC MAIN FRIO	35	178	1085	54.04	0.76	28	66	10	15.51	200	5	7100	78.03	1.241
YATES PERM. GUAD.	30	82	118	62.35	0.29	10	120	10	11.62	200	5	1250	50.13	1.228
WARD-ESTES NORTH	38	81	40	54.04	0.91	20	30	10	5.04	200	5	2500	72.68	1.198
TOM O'CONNOR 5900	35	176	2136	71.5	0.63	32	30	10	10.66	200	5	5900	58.55	1.178
GARZA	35	90	8	43.23	0.49	21	55	10	7.75	200	5	2500	47.02	1.139
VEALMOOR EAST	48	155	38	69.84	2.2	10	107	10	11.6	200	5	7400	49.80	1.138
EMPEROR DEEP	33	80	20	48.22	0.67	17	61	10	7.77	200	5	2900	51.17	1.120
GILLOCK, S. BIG GAS	38	154.8	900	64.02	1.41	28	36	10	10.02	200	5	9600	93.41	1.118
FALLS CITY LBAR., LPA.	39	190	371	62.35	0.73	30	25	10	7.26	200	5	6100	76.38	1.116
HELEN GOHLKE WILCOX	34	240	180	58.2	0.59	20	47	10	8.5	200	5	8100	69.74	1.109
PLYMOUTH HEEP	31	162	3300	66.51	0.52	28	28	10	8.1	200	5	5600	55.76	1.107

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue (Continued)

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
MIDLAND FARMS	32	102	61	66.51	0.72	14	100	10	14.46	200	5	4800	56.80	1.093
GLASCO DEVONIAN	37	186	200	58.2	1.39	14	67	10	8.48	200	5	12600	95.70	1.091
WEST RANCH 41-A	32	171	869	59.86	0.55	30	35	10	9.76	200	5	5700	70.21	1.081
FUHRMAN-MASCHO	32	95	5	54.04	0.71	13	72	10	7.86	200	5	4300	59.70	1.078
WHITE POINT E. BRIGHTON	39	162	575	51.55	0.83	33	26	10	6.87	200	5	5700	73.64	1.074
SLICK WILCOX	36	218	350	62.35	0.68	22	50	10	10.65	200	5	7300	76.46	1.044
WALNUT BEND HUDSPETH	40	110	138	50.71	0.99	20	40	10	6.3	200	5	3900	67.97	1.042
CONROE MAIN CONROE	38	170	1400	64.02	0.64	32	65	10	20.68	200	5	5200	79.68	1.037
WELCH	33	96	9	63.18	0.86	10	100	10	9.81	200	5	4900	69.92	1.036
EMBAR ELLENBURGER	45	115	40	62.35	2.32	5	195	10	9.44	200	5	7700	62.44	1.023
TOM O'CONNOR 5500	31	169	816	58.2	0.51	31	26	10	7.28	200	5	5500	63.98	1.007
VEALMOOR	46	164	32	57.37	1.83	10	95	10	8.46	200	5	7800	69.94	0.991
HAMLIN EAST	39	117	350	64.85	0.65	19	25	10	4.78	200	5	3200	67.70	0.987
EAST TEXAS WOODBINE	38	146	1300	71.5	0.56	25	35	10	9.72	200	5	3600	60.38	0.974
THOMPSON FRIO	25	168	1100	58.2	0.37	30	40	10	10.85	200	5	5400	47.80	0.966
SALT CREEK	40	129	10	59.03	1.31	12	100	10	11	200	5	6300	87.97	0.942
SAND HILLS MCKNIGHT	33	86	1	49.88	0.73	9	150	10	10.46	200	5	3500	52.91	0.928
CHOCOLATE BAYOU ALIBEL	42	225	400	58.2	1.27	29	26	10	6.81	200	5	9400	75.05	0.913
HALLEY	34	83	20	58.2	0.67	16	45	10	6.51	200	5	2700	70.33	0.904
CORDONA LAKE DEV.	40	103	15	49.88	1.49	18	60	10	8.37	200	5	5400	71.45	0.889
ADAIR WOLFCAMP	43	133	28	63.18	1.84	12	68	10	8.01	200	5	8500	76.25	0.883
TAYLOR-LINK	32	84	40	66.51	0.26	15	35	10	5.42	200	5	1300	49.73	0.877
SCARBOROUGH	37	85	12	49.88	1.07	17	55	10	7.24	200	5	3000	72.56	0.863
AMACKER-TIPPETT ELL.	53	201	23	70.67	4.28	6	285	10	18.77	200	5	12100	33.68	0.853
THOMPSON, S. 5400	25	155	900	59.03	0.42	31	29	10	8.24	200	5	5300	46.89	0.842
DARST CREEK EDWARDS	36	98.8	200	49.88	0.56	21	150	10	24.4	200	5	2600	57.93	0.841
HARDIN FRAZIER	38	141.2	500	62.35	1.21	24	26	10	6.04	200	5	7900	91.90	0.831
REINECKE	46	139	22	65.68	1.97	10	65	10	6.63	200	5	6800	62.39	0.827
HULL-SILK-SIKES 3800	39	108.4	180	62.35	0.83	17	26	10	4.28	200	5	3800	74.33	0.822
GATEWOOD	33	90.8	148	62.35	0.3	23	20	10	4.45	200	5	1600	58.88	0.814
SANDUSKY OIL CREEK	42	142	238	61.52	1.11	17	33	10	5.36	200	5	7200	80.78	0.814
DURKEE FAIRBANKS	35	191	2400	63.18	0.68	34	25	10	8.34	200	5	7100	72.99	0.806
FIG RIDGE SEABREEZE	35	198	750	52.38	0.81	27	34	10	7.47	200	5	8500	71.02	0.805
SHAFTER LAKE DEV.	38	135	6	64.02	1.53	5	140	10	6.96	200	5	9500	88.55	0.797
MANVEL F.B. II OLIG.	28	165	500	68.17	0.46	28	48	10	14.23	200	5	5700	45.10	0.785
OLD OCEAN CHENAULT	36	232	640	63.18	0.61	27	60	10	15.9	200	5	9600	72.90	0.782

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue (Continued)

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
THOMPSON, S. 4400	25	135	367	60.69	0.38	34	35	10	11.22	200	5	4400	44.88	0.778
UNION	33	110	2	70.67	0.98	11	55	10	6.64	200	5	6900	59.91	0.775
HARPER	36	92	2	54.04	0.79	10	50	10	4.2	200	5	4100	72.19	0.768
COWDEN S. 8790 CANYON	40	147	4	60.69	1.53	8	65	10	4.9	200	5	8800	92.41	0.767
MANVEL F.B. I OLIG.	28	165	500	68.17	0.42	28	48	10	14.23	200	5	5100	44.75	0.754
BRANTLEY JACKSON SMACK.	40	205	25	73.99	1.18	22	50	10	12.64	200	5	9200	63.20	0.748
TXL ELLENBURGER	44	138	39	70.67	2.2	4	240	10	10.54	200	5	9600	53.25	0.746
H-J STRAWN	42	122	100	59.86	1.22	9	50	10	4.18	200	5	5500	80.16	0.741
GANADO WEST 4700	24	146	1411	51.55	0.37	33	44	10	11.62	200	5	4700	35.79	0.735
CROSSETT DEV.	44	106	6	54.04	1.8	22	88	10	16.25	200	5	5400	64.14	0.730
GOLDSMITH	36	95	12	68.17	0.83	11	48	10	5.59	200	5	4100	66.72	0.728
PORTILLA 7400	40	206	1634	60.69	0.9	28	28	10	7.39	200	5	7400	76.23	0.726
HENDRICK	28	83	7	49.88	0.52	8	100	10	6.2	200	5	2500	33.21	0.715
RILEY N. U. CLFK.	32	107	12	55.7	0.99	8	70	10	4.84	200	5	6300	70.84	0.695
GOVT. WELLS, NORTH G:W.	21	114	800	58.2	0.17	32	20	10	5.78	200	5	2200	33.15	0.677
VON ROEDER AND N.V.R	43	134	13	66.51	1.57	10	45	10	4.65	200	5	6800	69.96	0.677
DOLLARHIDE CLEAR FORK	38	120	10	62.35	1.35	15	40	10	5.81	200	5	6500	89.41	0.676
TALCO PALUXY	22	147	2000	73.99	0.3	26	44	10	13.14	200	5	4300	20.78	0.675
SEELIGSON ZONE 19-C-4	43	125.2	585	64.02	1.56	24	25	10	5.97	200	5	5900	70.97	0.671
FAIRWAY JAMES LIME	48	260	18	60.69	1.97	11	70	10	7.26	200	5	10000	57.56	0.658
SIVELLS BEND	42	127	126	49.05	1.54	18	46	10	6.31	200	5	6600	66.26	0.657
SHARON RIDGE 2400	32	96	8	54.04	0.14	15	95	10	11.96	200	5	2400	53.78	0.652
LEVELLAND	30	105	2	61.52	0.54	11	50	10	5.26	200	5	4900	55.22	0.643
WORTHAM WOODBINE	39	101.2	1620	83.14	0.76	22	24	10	6.82	200	5	2900	44.26	0.642
GERALDINE-FORD	41	100	49	45.73	0.89	22	28	10	4.37	200	5	2600	49.64	0.626
KEYSTONE SIL.	39	120	3	74.82	1.52	6	113	10	7.88	200	5	8400	64.29	0.623
LIVINGSTON YEGUA	40	154	120	83.14	0.69	28	15	10	5.42	200	5	4500	47.40	0.622
BIG MINERAL CRK. BARNES	37	118	59	56.53	1.01	18	54	10	8.53	200	5	5300	85.19	0.622
COKE PALUXY	27	190	1175	59.86	0.4	22	50	10	10.23	200	5	6300	50.21	0.613
FORT STOCKTON	32	83	35	46.56	0.64	17	38	10	4.67	200	5	2800	43.15	0.600
GOLDSMITH DEVONIAN	40	135	47	62.35	1.37	15	45	10	6.54	200	5	8000	88.82	0.577
SALT FLAT AUSTIN CHALK	36	97.2	0.1	49.88	0.48	18	120	10	16.73	200	5	2400	57.23	0.571
LAWSON	37	94	6	57.45	0.9	10	36	10	3.21	200	5	4300	78.94	0.566
EDWARDS WEST CANYON	41	140	5	62.35	1.72	10	80	10	7.75	200	5	8700	86.33	0.562
FOSTER	35	95	7	62.35	0.8	10	110	10	10.65	200	5	4300	74.36	0.560
BRECKENRIDGE POOL	38	110	15	60.69	0.71	13	35	10	4.29	200	5	3100	75.32	0.557

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue (Continued)

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
TOMBALL SCHULTZ SE	40	182	1200	62.35	0.77	32	11	10	3.41	200	5	5500	74.29	0.554
SULPHUR BLUFF PALUXY	21	114	4000	49.88	0.38	25	60	10	11.62	200	5	4500	24.08	0.550
GILLOCK BIG GAS	38	214	1470	70.67	1	28	25	10	7.68	200	5	8400	64.33	0.548
UNIV. BLOCK 9 WOLFCAMP	38	140	14	60.69	1.26	10	40	10	3.77	200	5	8400	94.56	0.546
EMMA ELLENBURGER	49	185	54	66.51	3.16	3	290	10	8.99	200	5	12300	48.89	0.545
HULLDALE PENN. REEF	40	156	43	59.86	0.82	9	39	10	3.26	200	5	5800	82.42	0.534
TOM O'CONNOR 4500 GRETA	24	162	2290	56.53	0.29	33	20	10	5.79	200	5	4500	40.74	0.524
KELSEY M-2	47	160	454	60.69	1.31	25	16	10	3.77	200	5	4700	65.87	0.511
RINCON VICKSBURG SAND	44	140	284	64.02	1.36	22	50	10	10.94	200	5	5300	73.95	0.509
SUSAN PEAK	37	139	40	66.51	0.66	10	43	10	4.44	200	5	4700	72.88	0.508
FLUVANNA STRAWN	40	140	93	60.69	1.27	10	42	10	3.96	200	5	7800	90.70	0.507
COWDEN NORTH DEEP	37	107	7	66.51	0.98	8	40	10	3.31	200	5	5100	75.26	0.506
REEVES	32	113	3	53.21	0.65	12	45	10	4.46	200	5	5600	58.35	0.503
SNYDER	30	97	1	62.35	0.37	10	50	10	4.84	200	5	2600	52.30	0.492
RACCOON BEND COCKFIELD	34	155	840	68.17	0.47	33	40.9	10	14.29	200	5	4200	64.88	0.486
HARRIS	31	112	11	59.86	0.75	9	55	10	4.6	200	5	5900	64.23	0.482
SEELIGSON ZONE 19-B	41	179	546	60.69	0.94	24	16	10	3.62	200	5	6100	78.47	0.472
LA ROSA 5900	30	125.2	1682	83.14	0.72	29	24	10	8.99	200	5	5900	30.14	0.470
UNIV. BLOCK 9 PENN.	40	151	11	58.2	1.46	12	35	10	3.8	200	5	9000	90.81	0.465
SLAUGHTER	30	108	11	66.51	0.53	12	48	10	5.95	200	5	5000	47.18	0.462
HENDERSON	31	85	50	49.88	0.58	14	40	10	4.34	200	5	3100	44.58	0.454
FARGO 3900	41	109.2	100	58.2	0.97	17	22	10	3.38	200	5	3900	72.22	0.451
PAYTON	36	81	35	66.51	0.71	20	20	10	4.13	200	5	2000	62.96	0.448
GILLOCK EAST SEGMENT	39	224	1330	35.75	0.87	29	42.5	10	6.84	200	5	9600	51.11	0.448
MERCHANT EY-1B	30	205	230	65.68	0.6	31	28	10	8.85	200	5	8900	49.48	0.444
SHAMBURGER LAKE PALUXY	32	206	200	70.67	0.54	21	28	10	6.45	200	5	7300	44.88	0.435
LOMA NOVIA LOMA NOVIA	26	114	800	62.35	0.24	26	16	10	4.03	200	5	2600	37.92	0.433
SHAFTER LAKE SAN AND.	34	105	5	62.35	0.73	8	37	10	2.87	200	5	4400	70.57	0.428
KINGDOM ABO	30	121	5	64.02	0.83	7	70	10	4.87	200	5	7800	60.14	0.419
WEBSTER UPPER FRIO	29	163	2350	62.35	0.52	31	150	10	45.03	200	5	5800	56.31	0.416
KERMIT	34	83	14	54.04	0.73	15	22	10	2.77	200	5	2800	62.63	0.403
LUTHER S.E. SIL.-DEV.	44	168	16	66.51	1.86	15	65	10	10.07	200	5	9900	69.62	0.382
ARANSAS PASS	42	198	225	57.37	1.12	28	20	10	4.99	200	5	7100	74.73	0.374
LOVELL'S LAKE FRIO 1	38	167	450	49.88	1.04	29	45	10	10.11	200	5	7700	81.14	0.371
DOLLARHIDE SILURIAN	42	120	9	64.85	1.94	6	194	10	11.72	200	5	8500	70.76	0.370
FLANAGAN U. CLFK.	32	113	3	60.69	0.61	13	45	10	5.51	200	5	6300	64.84	0.355

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue (Continued)

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
EMMA	33	104	11	63.85	0.58	7	58	10	4.03	200	5	4000	63.77	0.354
KMA	40	125	55	62.35	0.8	16	24	10	3.72	200	5	3700	72.54	0.350
WILLAMAR, W. W. WILLA.	31	212	65	53.21	0.59	19	34	10	5.34	200	5	7900	52.04	0.345
RUSSELL 7000 CLFK.	35	127	2	62.35	0.81	5	95	10	4.6	200	5	7000	78.96	0.335
TAFT 4000	23	133	1500	64.02	0.32	25	30	10	7.46	200	5	4000	36.24	0.326
TEX-HAMON FUSSELMAN	40	154	25	54.04	1.86	7	65	10	3.82	200	5	11600	87.54	0.325
UNIV. BLOCK 9 DEV.	45	176	3	69	2.03	5	107	10	5.73	200	5	10500	58.36	0.315
HAYNES MITCHELL	40	148	25	56.53	1.04	17	18	10	2.69	200	5	5900	82.49	0.313
LEA ELLENBURGER	43	138	300	78.15	1.88	2	202	10	4.9	200	5	8200	49.90	0.311
TUNSTILL	40	88	30	51.55	1.16	25	12	10	2.4	200	5	3300	67.97	0.310
HOBO	46	150	32	58.2	1.72	10	39	10	3.53	200	5	7100	69.67	0.292
TWOFREDS DELAWARE	35	104	33	46.56	1	20	21	10	3.04	200	5	4900	59.57	0.286
WALNUT BEND WINGER	32	143	309	69	0.69	17	21	10	3.83	200	5	5500	55.35	0.280
WILLAMAR WILLAMAR	30	200	140	62.35	0.59	23	20	10	4.45	200	5	7600	54.10	0.279
CAYUGA WOODBINE	29	160	500	66.51	0.23	25	35	10	9.04	200	5	4000	49.16	0.278
KEYSTONE ELLENBURGER	44	144	5	54.87	2.21	3	300	10	7.67	200	5	9600	67.51	0.272
HEYSER 5400	34	164	300	54.04	0.62	24	13	10	2.62	200	5	5400	70.06	0.264
MCELROY	32	86	50	65.51	0.61	16	86	10	14	200	5	2900	56.48	0.261
HOWARD-GLASSCOCK GLOR.	27	100	4	58.2	0.29	11	60	10	5.97	200	5	3200	43.33	0.257
GOLDSMITH NORTH	35	95	2	59.86	0.79	8	35	10	2.6	200	5	4400	74.79	0.253
WEST RANCH 98-A	40	178	497	58.2	0.88	30	32	10	8.68	200	5	6100	81.90	0.248
KEYSTONE HOLT	40	92	58	59.03	1.39	18	55	10	9.08	200	5	4800	84.55	0.246
HITTS LAKE PALUXY	26	175	400	74.82	0.49	22	32	10	8.18	200	5	7200	25.39	0.244
SHARON RIDGE 1700	28	90	3	52.38	0.26	15	35	10	4.27	200	5	1700	35.52	0.235
KELLY-SNYDER	42	130	19	64.85	1.56	8	137	10	11.04	200	5	6700	74.57	0.227
TOM O'CONNOR 5800	36	176	1758	69.84	0.67	32	16	10	5.55	200	5	5800	62.39	0.226
NEVA WEST STRAWN	46	158	8	59.86	1.38	10	80	10	7.44	200	5	6200	71.61	0.224
DOLLARHIDE ELL.	41	139	5	55.7	1.88	3	187	10	4.85	200	5	10000	80.67	0.201
AMROW DEVONIAN	35	178	34	58.2	1.29	4	131	10	4.74	200	5	12600	92.41	0.200
SEELIGSON ZONE 14-B	40	164	353	54.04	0.86	26	11	10	2.4	200	5	5100	75.19	0.196
LOLITA WARD ZONE	32	171	635	57.37	0.56	30	10	10	2.67	200	5	5900	66.20	0.194
ROUND TOP PALO PINTO	40	140	6	62.35	0.82	10	90	10	8.72	200	5	4800	79.32	0.182
FARMER	30	95.6	4	59.03	0.34	10	75	10	6.88	200	5	2200	52.99	0.175
DOLLARHIDE DEVONIAN	40	120	17	59.86	1.58	14	70	10	9.11	200	5	8000	87.15	0.172
GIDDINGS AUSTIN CHALK	40	225	0.1	36.58	0.94	6	150	10	5.11	200	5	7500	48.01	0.170
COGDELL	42	136	18	54.04	1.49	10	73	10	6.13	200	5	6800	77.31	0.166

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue (Continued)

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
DARST CREEK BUDA	32	95.6	0.1	42.4	0.3	12	90	10	7.11	200	5	2200	35.46	0.165
VAUGHN	28	90	10	51.63	0.21	14	30	10	3.37	200	5	1500	32.95	0.154
MABEE	32	106	8	48.22	0.67	11	40	10	3.3	200	5	4700	47.78	0.118
GRETA 4400	24	145	687	60.69	0.34	33	25	10	7.78	200	5	4400	43.28	0.113
SOJOURNER	41	120.4	15	58.2	1.13	14	19	10	2.4	200	5	5300	77.32	0.113
BEDFORD DEVONIAN	41	138	5	54.04	1.62	11	100	10	9.23	200	5	8800	80.88	0.112
FLOUR BLUFF PHILLIPS	44	186	745	49.88	1.2	31	25	10	6	200	5	6600	58.67	0.099
DIAMOND M	44	130	72	59.86	1.81	9	80	10	6.69	200	5	6600	73.91	0.097
COTTONWOOD CR. SOUTH	36	220	790	46.56	0.68	22	22	10	3.5	200	5	7600	53.73	0.087
DUNE	34	88	6	61.11	0.72	10	80	10	7.59	200	5	3300	71.63	0.085
ELIASVILLE POOL	39	115	8	62.35	0.59	12	27	10	3.14	200	5	3300	69.23	0.083
KILDARE RODESSA	40	158	27	66.51	0.86	16	17	10	2.81	200	5	6000	71.53	0.079
GARCIA GARCIA MAIN	47	152	1285	68.17	1.04	32	12	10	4.07	200	5	3800	48.18	0.079
NOLLEY WOLFCAMP	37	130	20	59.86	1.51	9	60	10	5.02	200	5	9100	94.07	0.076
OCEANIC	42	160	84	68.17	1.37	12	60	10	7.62	200	5	8100	74.15	0.075
HEADLEE ELLENBURGER	51	208	40	66.51	3.71	2	325	10	6.71	200	5	13300	42.67	0.071
BIG LAKE	36	125	20	66.51	0.45	19	30	10	5.89	200	5	3000	64.17	0.069
SPRABERRY TREND	39	132	0.3	54.04	1.02	10	25	10	2.1	200	5	6800	78.46	0.065
KATZ 5100	37	120	56	53.21	0.89	16	35	10	4.63	200	5	5100	75.02	0.055
ELKHORN ELLENBURGER	39	179	34	83.14	0.93	2	121	10	3.12	200	5	7200	57.78	0.054
CHOCOLATE BAYOU U. FRIO	42	212	1090	54.87	1.23	28	27	10	6.44	200	5	8800	71.74	0.049
FULLERTON SOUTH ELL.	44	132	77	70.67	2.54	2	275	10	6.04	200	5	10700	51.77	0.048
HARPER ELLENBURGER	46	163	2	58.2	2.4	2	225	10	4.07	200	5	12300	66.66	0.043
SAND HILLS TUBB	35	96	30	49.88	0.96	12	47	10	4.37	200	5	4500	67.73	0.04
FARNSWORTH U. MORROW	38	170	48	57.37	0.65	15	21	10	2.81	200	5	7900	78.05	0.04
FULLERTON 8500 DEV.	45	120	50	62.35	2.49	8	40	10	3.1	200	5	8500	66.43	0.034
CROSSETT SOUTH DEV.	42	107	3	49.88	1.55	19	80	10	11.78	200	5	5600	64.33	0.022
BOYD CONGL.	40	136	55	54.04	1.09	14	27	10	3.17	200	5	6000	78.88	0.012
TOMBALL KOBS	40	182	1000	57.37	0.77	31	6.5	10	1.8	200	5	5500	74.44	0.008
EL MAR DELAWARE	41	114	14	45.73	1.16	22	15	10	2.34	200	5	4500	56.33	0.008
MAGNET-WITHERS	26	171	1700	60.69	0.4	29	67	10	18.31	200	5	5600	50.33	0.002

5.0 Conclusions

Of the 431 reservoirs screened, 211 projected revenue that exceeded cost, i.e., were profitable. Only the top 154 reservoirs, however, showed a profit greater than 30 percent. The top ten reservoirs predicted a profit of at least 80 percent. Six of the top ten were Gulf Coast sandstones.

The reservoirs are representative of the most productive discoveries in Texas. They account for approximately 72 percent of the recorded 52 billion barrels of oil production in the State. The preliminary evaluation of the reservoirs performed in this study implied that potential production from CO_2-EOR could be as much as 4 billion barrels.

In order to enhance the chances of achieving this increase in production, the Department of Energy should consider a concerted effort to follow up this analysis with a targeted outreach program to the specific independent operators controlling the leases applicable to these reservoirs/resources. Development of ownership/technical potential maps and an outreach program should be initiated to aid this identification.

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Appendix A

Texas Reservoir Database

Table A1. Texas Reservoir Database

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42163	BIG FOOT OLMOS B	1	GULF COAST BASIN	OLMOS	SS	SG	3300.0	13.0	580	3.00	43.00	31.33
42127	BIG WELLS SAN MIGUEL	1	GULF COAST BASIN	SAN MIGUEL	SS	SG+LGCE	5400.0		200	6.00	33.00	54.58
42013	CHARLOTTE NAVARRO	1	GULF COAST BASIN	NAVARRO	SS	SG+MGCE	5100.0	20.0	260	20.00	34.00	40.24
42187	DARST CREEK BUDA	1	GULF COAST BASIN	BUDA LIME	LS	SG	2200.0	90.0		0.10	32.00	63.20
42187	DARST CREEK EDWARDS	1	GULF COAST BASIN	EDWARDS	DO,LS	WD	2600.0	150.0	200	200.00	36.00	93.50
42013	JOURDANTON EDWARDS	1	GULF COAST BASIN	EDWARDS	DO,LS	WD+MGCE	7300.0	55.0	400	23.00	38.00	13.60
42055	LULING-BRANYON AUSTIN	1	GULF COAST BASIN	AUSTIN CHALK	LS	SG	1900.0	30.0	300	0.10	36.00	160.75
42055	LULING-BRANYON EDWARDS	1	GULF COAST BASIN	EDWARDS	DO,LS	WD	2200.0	0.0	150	200.00	36.00	138.00
42055	LYTTON SPRINGS	1	GULF COAST BASIN	TAYLOR	TUFF	SG+GD	1300.0	0.0		7.00	38.00	11.27
42163	PEARSALL AUSTIN CHALK	1	GULF COAST BASIN	AUSTIN CHALK	LS	SG,GD	5300.0	40.0		0.10	28.00	72.75
42323	SACATOSA SAN MIGUEL	1	GULF COAST BASIN	SAN MIGUEL	SS	SG	1200.0	22.0	615	4.00	32.00	30.36
42055	SALT FLAT AUSTIN CHALK	1	GULF COAST BASIN	AUSTIN CHALK	LS	SG	2400.0	120.0	500	0.10	36.00	78.57
42055	SALT FLAT EDWARDS	1	GULF COAST BASIN	EDWARDS	DO,LS	WD	2725.0	15.0			30.00	63.70
42013	SOMERSET OLMOS B	1	GULF COAST BASIN	OLMOS	SS	SG	1000.0	10.0		85.00	34.00	26.28
42013	WEIGANG CARRIZO	1	GULF COAST BASIN	CARRIZO WILCOX	SS	WD	3900.0	30.0		1357.00	24.00	11.19
42175	BERCLAIR VICKSBURG	2	GULF COAST BASIN	VICKSBURG	SS	COMBINED	3200.0		23	1000.00	27.00	12.13
42469	BLOOMINGTON 4600	2	GULF COAST BASIN	GRETA	SS	WD	4600.0	20.0	40	1140.00	23.00	31.57
42391	BONNIE VIEW	2	GULF COAST BASIN	GRETA	SS	WD	4500.0	24.0	30	1000.00	24.00	19.62
42123	COTTONWOOD CR. SOUTH	2	GULF COAST BASIN	WILCOX	SS	WD+GCE	7600.0	22.0	20	790.00	36.00	11.09
42255	FALLS CITY LBAR., LPA.	2	GULF COAST BASIN	LOWER WILCOX	SS	WD	6100.0	25.0	50	371.00	39.00	25.40
42239	FRANCITAS NORTH	2	GULF COAST BASIN	FRIO	SS	COMBINED	8500.0		18	1800.00	49.00	11.81
42239	GANADO WEST 4700	2	GULF COAST BASIN	GRETA	SS	WD	4700.0	44.0	80	1411.00	24.00	27.60
42391	GRETA 4400	2	GULF COAST BASIN	FRIO	SS	WD	4400.0	25.0	65	687.00	24.00	133.23
42469	HELEN GOHLKE WILCOX	2	GULF COAST BASIN	WILCOX	SS	WD+GCE	8100.0	47.0	65	180.00	34.00	24.18
42057	HEYSER 5400	2	GULF COAST BASIN	FRIO	SS	WD+MSG	5400.0	13.0	36	300.00	34.00	10.40
42391	LA ROSA 5400	2	GULF COAST BASIN	FRIO	SS	WD	5400.0		39	0.00	30.00	10.00
42391	LA ROSA 5900	2	GULF COAST BASIN	FRIO	SS	WD+GCE	5900.0	24.0	25	1682.00	30.00	15.53
42239	LA WARD NORTH	2	GULF COAST BASIN	MARGINULINA	SS	GCE+MWD	5200.0	18.0	33	350.00	26.00	19.52
42391	LAKE PASTURE H-440 S	2	GULF COAST BASIN	UPPER GRETA	SS	WD+SG	4500.0	75.0	50	1197.00	24.00	51.82
42239	LOLITA MARGINULINA	2	GULF COAST BASIN	MARGINULINA	SS	WD+PSG	5300.0	7.0	25	164.00	26.00	15.56
42239	LOLITA WARD ZONE	2	GULF COAST BASIN	FRIO	SS	WD	5900.0	10.0	30	635.00	32.00	14.36
42239	MAURBRO MARGINULINA	2	GULF COAST BASIN	MARGINULINA	SS	WD+GCE	5200.0	9.0	34	450.00	25.00	26.03
42469	MCFADDIN 4400	2	GULF COAST BASIN	GRETA	SS	WD	4400.0	40.0	53	287.00	25.00	30.33
42391	M. E. O'CONNOR FQ-40	2	GULF COAST BASIN	FRIO	SS	WD	5900.0	20.0		820.00	40.00	18.07
42255	PERSON EDWARDS	2	GULF COAST BASIN	EDWARDS	DO,LS	GCE	10850.0	30.0	120	2.60	40.00	16.65
42025	PETTUS PETTUS	2	GULF COAST BASIN	PETTUS	SS	GCE	3900.0	16.0	81	452.00	44.00	16.54

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42469	PLACEDO 4700 SAND	2	GULF COAST BASIN	GRETA	SS	WD	4700.0	0.0	40	847.00	24.00	43.08
42123	SLICK WILCOX	2	GULF COAST BASIN	WILCOX	SS	WD+MGCE	7300.0	50.0	50	350.00	36.00	19.91
42391	TOM O'CONNOR 4400	2	GULF COAST BASIN	FRIO	SS	SG+WD	4400.0	4.2	15	578.00	24.00	14.22
42391	TOM O'CONNOR 4500 GR.	2	GULF COAST BASIN	GRETA	SS	WD	4500.0	20.0	20	2290.00	24.00	18.90
42391	TOM O'CONNOR 5500	2	GULF COAST BASIN	LOWER FRIO	SS	SG+PWD	5500.0	26.0	80	816.00	31.00	113.50
42391	TOM O'CONNOR 5800	2	GULF COAST BASIN	FRIO	SS	COMBINED	5800.0	16.0	200	1758.00	36.00	248.16
42391	TOM O'CONNOR 5900	2	GULF COAST BASIN	FRIO	SS	WD	5900.0	30.0	150	2136.00	35.00	262.77
42239	WEST RANCH 41-A	2	GULF COAST BASIN	FRIO	SS	WD	5700.0	35.0	60	869.00	32.00	99.04
42239	WEST RANCH 98-A	2	GULF COAST BASIN	FRIO	SS	WD	6100.0	32.0	70	497.00	40.00	59.00
42239	WEST R'NCH GLASSCOCK	2	GULF COAST BASIN	FRIO	SS	GCE+WD	5500.0	36.0	95	394.00	31.00	45.74
42239	WEST RANCH GRETA	2	GULF COAST BASIN	GRETA	SS	WD	5100.0	33.0	48	1000.00	24.00	99.24
42239	WEST RANCH WARD	2	GULF COAST BASIN	FRIO	SS	WD+GCE	5700.0	13.0	30	1228.00	31.00	30.28
42245	AMELIA FRIO 6	3	GULF COAST BASIN	FRIO	SS	WD+GCE	6800.0	12.0	20	1390.00	30.00	27.50
42071	ANAHUAC MAIN FRIO	3	GULF COAST BASIN	FRIO	SS	WD+GCE	7100.0	66.0	125	1085.00	35.00	275.87
42199	BATSON CAPROCK	3	GULF COAST BASIN	CAPROCK	LS	GCE+GD	1100.0	26.0			30.00	44.94
42071	CEDAR POINT FRIO 5900	3	GULF COAST BASIN	FRIO	SS	WD+GCE	6000.0	9.0	75	900.00	38.00	18.56
42039	CHOCOLATE BAYOU, ALI.	3	GULF COAST BASIN	ALIBEL FRIO	SS	WD	9400.0	26.0	52	400.00	42.00	14.43
42039	CHOCOLATE BAYOU, U.F.	3	GULF COAST BASIN	UPPER FRIO	SS	GCE+WD	8800.0	27.0	20	1090.00	42.00	17.45
42201	CLEAR LAKE FRIO	3	GULF COAST BASIN	FRIO	SS	WD+GCE	5900.0	40.0	60	977.00	26.00	23.99
42339	CONROE MAIN CONROE	3	GULF COAST BASIN	COCKFIELD	SS	WD+GCE	5200.0	65.0	160	1400.00	38.00	706.37
42201	DURKEE FAIRBANKS	3	GULF COAST BASIN	FAIRBANKS	SS	WD+GCE	7100.0	25.0	40	2400.00	35.00	13.24
42291	ESPERSON DOME S. CROCKETT	3	GULF COAST BASIN	CROCKETT	SS	COMBINED	7300.0	176.0	1800	240.00	39.00	17.34
42201	FAIRBANKS FAIRBANKS	3	GULF COAST BASIN	YEGUA	SS	GCE	6800.0	91.0	26	2000.00	36.00	41.24
42071	FIG RIDGE SEABREEZE	3	GULF COAST BASIN	FRIO	SS	SG+WD	8500.0	34.0	100	750.00	35.00	48.77
42287	GIDDINGS AUSTIN CHALK	3	GULF COAST BASIN	AUSTIN CHALK	LS	SG	7500.0	150.0		0.10	40.00	193.47
42167	GILLOCK BIG GAS	3	GULF COAST BASIN	FRIO	SS	COMBINED	8400.0	25.0	505	1470.00	38.00	34.01
42167	GILLOCK EAST SEGMENT	3	GULF COAST BASIN	FRIO	SS	WD	9600.0	42.5	370	1330.00	39.00	21.94
42167	GILLOCK, S. BIG GAS	3	GULF COAST BASIN	FRIO	SS	WD+GCE	9600.0	36.0	574	900.00	38.00	45.46
42291	HARDIN FRAZIER	3	GULF COAST BASIN	COCKFIELD	SS	WD	7900.0	26.0	100	500.00	38.00	22.35
42039	HASTINGS, E. U. FRIO	3	GULF COAST BASIN	UPPER FRIO	SS	WD+GCE	6100.0	8.0	145	720.00	32.00	56.88
42039	HASTINGS, W. FRIO	3	GULF COAST BASIN	FRIO	SS	COMBINED	6100.0	163.0	625	865.00	31.00	619.15
42201	HOUSTON, S. FRIO	3	GULF COAST BASIN	FRIO	SS	WD+GCE	4800.0	0.0	295	710.00	27.00	42.37
42201	HOUSTON, S. MIOCENE	3	GULF COAST BASIN	MIOCENE	SS	WD+GCE	4000.0	0.0	180	100.00	22.00	14.90
42201	HUMBLE CAPROCK	3	GULF COAST BASIN	CAPROCK	LS	GCE+GD	1200.0	80.0		0.00	22.00	168.13
42473	KATY I-B	3	GULF COAST BASIN	YEGUA	SS	GCE+WD	6600.0	18.0	12	1050.00	43.00	15.10

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42041	KURTEN WOODBINE	3	EAST TEXAS	WOODBINE	SS	SG	8300.0	27.0		2.00	38.00	13.76
42373	LIVINGSTON WILCOX	3	GULF COAST BASIN	WILCOX	SS	WD	7400.0	81.0	80	70.00	35.00	19.95
42373	LIVINGSTON YEGUA	3	GULF COAST BASIN	YEGUA	SS	WD+GCE	4500.0	15.0	45	120.00	40.00	20.66
42245	LOVELL'S LAKE FRIO 1	3	GULF COAST BASIN	FRIO	SS	WD+GCE	7700.0	45.0	10	450.00	38.00	10.30
42245	LOVELL'S LAKE FRIO 2	3	GULF COAST BASIN	FRIO	SS	WD+GCE	7900.0	0.0	50	454.00	38.00	17.03
42481	MAGNET-WITHERS	3	GULF COAST BASIN	FRIO	SS	WD+GCE	5600.0	67.0	20	1700.00	26.00	91.99
42039	MANVEL F.B. I OLIG.	3	GULF COAST BASIN	OLIGOCENE	SS	WD+GCE	5100.0	48.0	129	500.00	28.00	42.32
42039	MANVEL F.B. II OLIG.	3	GULF COAST BASIN	OLIGOCENE	SS	WD+GCE	5700.0	48.0	126	500.00	28.00	34.14
42321	MARKHAM N.-BCN CARLSON	3	GULF COAST BASIN	FRIO	SS	WD+GCE	7000.0		25	3333.00	36.00	13.81
42321	MARKHAM N.-BCN CORNELIUS	3	GULF COAST BASIN	FRIO	SS	WD+GCE	8400.0		40	750.00	36.00	18.19
42291	MERCHANT EY-1B	3	GULF COAST BASIN	YEGUA	SS	COMBINED	8900.0	28.0	918	230.00	30.00	23.21
42407	MERCY 8260 WILCOX	3	GULF COAST BASIN	WILCOX	SS	WD	8300.0	15.0	37	256.00	38.00	13.33
42039	OLD OCEAN ARMSTRONG	3	GULF COAST BASIN	FRIO	SS	GCE	10000.0		83	251.00	37.00	68.09
42039	OLD OCEAN CHENAULT	3	GULF COAST BASIN	FRIO	SS	GCE	9600.0	60.0	60	640.00	36.00	10.16
42071	OYSTER BAYOU SEABREEZE	3	GULF COAST BASIN	SEABREEZE	SS	WD+GCE	8300.0	150.0	177	1325.00	36.00	138.19
42481	PICKETT RIDGE	3	GULF COAST BASIN	FRIO	SS	WD+GCE	4700.0	10.0	80	312.00	25.00	16.08
42015	RACCOON BEND COCKFIELD	3	GULF COAST BASIN	COCKFIELD	SS	WD	4200.0	40.9		840.00	34.00	59.00
42373	SEGNO YEGUA	3	GULF COAST BASIN	YEGUA	SS	COMBINED	5200.0		10	713.00	41.00	11.52
42373	SEGNO, DEEP WILCOX	3	GULF COAST BASIN	UPPER WILCOX	SS	SG+WD	8200.0				38.00	14.90
42199	SILSBEE FIRST YEGUA	3	GULF COAST BASIN	YEGUA	SS	WD+GCE	7000.0	0.0	25	500.00	41.00	23.63
42199	SOUR LAKE CAPROCK	3	GULF COAST BASIN	CAPROCK	LS	GCE+GD	600.0	20.0			22.00	132.75
42245	SPINDLETOP CAPROCK	3	GULF COAST BASIN	CAPROCK	LS	GCE+GD	800.0	40.0			22.00	154.68
42321	SUGAR VALLEY N. LAURENCE	3	GULF COAST BASIN	FRIO	SS	WD+GCE	8900.0	0.0	37	600.00	32.00	6.30
42157	SUGARLAND UPPER FRIO	3	GULF COAST BASIN	UPPER FRIO	SS	GCE+WD	3800.0	85.0	575	900.00	29.00	73.25
42157	THOMPSON FRIO	3	GULF COAST BASIN	FRIO	SS	WD+GCE	5400.0	40.0	250	1100.00	25.00	360.42
42157	THOMPSON, N. U. VICKSBURG	3	GULF COAST BASIN	UPPER VICKSBURG	SS	WD+SG	7800.0		150	3400.00	36.00	28.28
42157	THOMPSON, S. 4400	3	GULF COAST BASIN	MIOCENE	SS	WD	4400.0	35.0	130	367.00	25.00	24.80
42157	THOMPSON, S. 5400	3	GULF COAST BASIN	MARGINULINA	SS	WD+GCE	5300.0	29.0	80	900.00	25.00	10.70
42201	TOMBALL KOBS	3	GULF COAST BASIN	COCKFIELD	SS	WD+GCE	5500.0	6.5	20	1000.00	40.00	59.55
42201	TOMBALL SCHULTZ SE	3	GULF COAST BASIN	COCKFIELD	SS	WD+GCE	5500.0	11.0	20	1200.00	40.00	37.20
42071	TRINITY BAY FRIO 12	3	GULF COAST BASIN	FRIO	SS	WD+GCE	8100.0	7.0	11	2344.00	36.00	24.16
42071	TURTLE BAY MIDDLETON	3	GULF COAST BASIN	FRIO	SS	WD	6600.0	10.0	40	1000.00	31.00	12.29
42201	WEBSTER UPPER FRIO	3	GULF COAST BASIN	UPPER FRIO	SS	WD+GCE	5800.0	150.0	400	2350.00	29.00	571.50
42481	WITHERS NORTH	3	GULF COAST BASIN	MARGINULINA	SS	WD+GCE	5300.0	16.0	70	2500.00	26.00	50.30
42007	ARANSAS PASS	4	GULF COAST BASIN	FRIO	SS	SG+MWD	7100.0	20.0	16	225.00	42.00	20.27
42355	ARNOLD DAVID CHAPMAN	4	GULF COAST BASIN	FRIO	SS	WD	6100.0	20.0	69	917.00	42.00	10.52

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42479	AVIATORS MIRANDO	4	GULF COAST BASIN	MIRANDO	SS	SG+WD	1700.0	13.0	51	357.00	21.00	10.37
42247	COLORADO COCKFIELD	4	GULF COAST BASIN	COCKFIELD	SS	SG	2600.0		300	800.00	45.00	21.91
42131	CONOCO DRISCOLL U.1G.W.	4	GULF COAST BASIN	GOVERNMENT WELLS	SS	GCE	2800.0	12.0	54	458.00	33.00	29.44
42505	ESCOBAS MIRANDO	4	GULF COAST BASIN	MIRANDO	SS	SG	1200.0	17.0	70	500.00	23.00	13.07
42355	FLOUR BLUFF PHILLIPS	4	GULF COAST BASIN	FRIO	SS	GCE+WD	6600.0	25.0	20	745.00	44.00	18.73
42427	GARCIA GARCIA MAIN	4	GULF COAST BASIN	VICKSBURG	SS	LWD+GCE	3800.0	12.0	80	1285.00	47.00	29.18
42131	GOVT. WELLS, NORTH G.W.	4	GULF COAST BASIN	GOVERNMENT WELLS	SS	SG+WD	2200.0	20.0	60	800.00	21.00	80.03
42131	GOVT. WELLS, SOUTH G.W.	4	GULF COAST BASIN	GOVERNMENT WELLS	SS	SG	2300.0		89	600.00	21.00	18.15
42131	HOFFMAN DOUGHERTY	4	GULF COAST BASIN	JACKSON	SS	SG	2000.0	10.0	250	757.00	23.00	48.81
42247	KELSEY M-2	4	GULF COAST BASIN	CATAHOULA	SS	GCE+SG	4700.0	16.0	93	454.00	47.00	10.80
42131	LOMA NOVIA LOMA NOVIA	4	GULF COAST BASIN	LOMA NOVIA	SS	SG	2600.0	16.0	240	800.00	26.00	48.61
42355	LONDON GIN DOUGHTY	4	GULF COAST BASIN	CATAHOULA	SS	WD	4500.0	14.0	47	1698.00	32.00	14.40
42479	LOPEZ FIRST MIRANDO	4	GULF COAST BASIN	MIRANDO	SS	COMBINED	2200.0	15.0	70	250.00	22.00	31.35
42409	MIDWAY MAIN MIDWAY	4	GULF COAST BASIN	MIDWAY	SS	WD+GCE	5300.0	25.0	15	4500.00	27.00	16.60
42479	MIRANDO CITY MIRANDO	4	GULF COAST BASIN	MIRANDO	SS	COMBINED	1600.0	26.0	35	1600.00	21.00	12.30
42479	O'HERN PETTUS	4	GULF COAST BASIN	PETTUS	SS	SG	2700.0	23.0	200	286.00	28.00	22.46
42131	PIEDRE LUMBRE G.W.	4	GULF COAST BASIN	GOVERNMENT WELLS	SS	WD+SG	1900.0	15.0	65	300.00	22.00	21.13
42409	PLYMOUTH HEEP	4	GULF COAST BASIN	FRIO	SS	WD+GCE	5600.0	28.0	30	3300.00	31.00	53.40
42409	PORTILLA 7300	4	GULF COAST BASIN	FRIO	SS	WD	7300.0	10.0	44	1412.00	40.00	12.61
42409	PORTILLA 7400	4	GULF COAST BASIN	FRIO	SS	WD	7400.0	28.0	130	1634.00	40.00	44.84
42247	PRADO MIDDLE LOMA NOVIA	4	GULF COAST BASIN	LOMA NOVIA	SS	SG+GCE	3700.0	10.0	65	850.00	40.00	23.66
42427	RINCON FRIO D-5	4	GULF COAST BASIN	FRIO	SS	COMBINED	3800.0	13.0	149	206.00	38.00	8.10
42427	RINCON FRIO E1+E2	4	GULF COAST BASIN	FRIO	SS	GCE	4000.0	10.0	157	161.00	40.00	9.70
42427	RINCON VICKSBURG SAND	4	GULF COAST BASIN	VICKSBURG	SS	COMBINED	5300.0	50.0	570	284.00	44.00	17.83
42249	SEELIGSON ZONE 10	4	GULF COAST BASIN	FRIO	SS	GCE+LWD	4600.0	0.0	24	766.00	39.00	11.00
42249	SEELIGSON ZONE 14-B	4	GULF COAST BASIN	FRIO	SS	GCE+WD	5100.0	11.0	35	353.00	40.00	18.13
42249	SEELIGSON ZONE 16	4	GULF COAST BASIN	FRIO	SS	GCE	5700.0			214.00	40.00	11.00
42249	SEELIGSON ZONE 19-B	4	GULF COAST BASIN	FRIO	SS	GCE	6100.0	16.0	175	546.00	41.00	17.32
42249	SEELIGSON ZONE 19-C-4	4	GULF COAST BASIN	FRIO	SS	GCE	5900.0	25.0	212	585.00	43.00	80.00
42249	SEELIGSON ZONE 20-C	4	GULF COAST BASIN	FRIO	SS	GCE	6100.0		42	513.00	40.00	10.00
42131	SEVEN SISTERS G.W.	4	GULF COAST BASIN	GOVERNMENT WELLS	SS	SG+WD	2330.0	16.0	75	225.00	20.00	55.96

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42355	STRATTON BERTRAM WARDNER	4	GULF COAST BASIN	FRIO	SS	GCE	6500.0	23.0	200	220.00	43.00	18.60
42427	SUN FRIO D-1	4	GULF COAST BASIN	FRIO	SS	GCE	4300.0	13.0	109	549.00	45.00	26.12
42409	TAFT 4000	4	GULF COAST BASIN	CATAHOULA	SS	WD	4000.0	30.0	73	1500.00	23.00	25.28
42273	T.C.B. 21-B	4	GULF COAST BASIN	FRIO	SS	GCE	7100.0		117	186.00	40.00	45.00
42249	WADE CITY BIERSTADT	4	GULF COAST BASIN	FRIO	SS	WD	4800.0	12.0			29.00	10.08
42409	WHITE POINT E. BRIGHTON	4	GULF COAST BASIN	FRIO	SS	WD	5700.0	26.0	82	575.00	39.00	86.69
42489	WILLAMAR WILLAMAR	4	GULF COAST BASIN	WILLAMAR	SS	SG+GCE	7600.0	20.0	143	140.00	30.00	26.05
42489	WILLAMAR, W. W. WILLA.	4	GULF COAST BASIN	WILLAMAR	SS	SG+GCE	7900.0	34.0	160	65.00	31.00	53.20
42223	BRANTLEY JACKSON SMACK.	5	EAST TEXAS	SMACKOVER	DO,LS	SG	9200.0	50.0	240	25.00	40.00	15.62
42349	CHENEYBORO COTTON VAL.	5	EAST TEXAS	COTTON VALLEY	LS	SG	9700.0	15.0		12.00	50.00	2.00
42349	CORSICANA SHALLOW	5	EAST TEXAS	NAVARRO	SS	COMBINED	1200.0		84	28.00	36.00	43.44
42293	MEXIA WOODBINE	5	EAST TEXAS	WOODBINE	SS	WD	3000.0	40.0	110	1600.00	35.00	109.32
42223	PICKTON BACON LIME	5	EAST TEXAS	BACON LIME	LS	SG	7900.0	8.1	37	252.00	46.00	16.32
42349	POWELL WOODBINE	5	EAST TEXAS	WOODBINE	SS	WD	2900.0	88.0	150	1600.00	36.00	131.40
42223	SULPHUR BLUFF PALUXY	5	EAST TEXAS	PALUXY	SS	WD	4500.0	60.0	150	4000.00	21.00	32.14
42467	VAN WOODBINE	5	EAST TEXAS	WOODBINE	SS	WD	2700.0	250.0	700	1000.00	34.00	584.70
42161	WORTHAM WOODBINE	5	EAST TEXAS	WOODBINE	SS	WD	2900.0	24.0	50	1620.00	39.00	24.70
42001	FAIRWAY JAMES LIME	56	EAST TEXAS	JAMES LIME	LS	SG	10000.0	70.0	130	18.00	48.00	187.86
42365	BETHANY GLEN ROSE, 4300	6	EAST TEXAS	GLEN ROSE	LS	SG	4300.0	7.0		203.00	43.00	15.43
42365	BETHANY N.E. LIME, 3850	6	EAST TEXAS	GLEN ROSE	LS	SG	3900.0	9.0	30	28.00	43.00	13.95
42001	CAYUGA WOODBINE	6	EAST TEXAS	WOODBINE	SS	WD	4000.0	35.0	20	500.00	29.00	62.76
42499	COKE PALUXY	6	EAST TEXAS	PALUXY	SS	WD	6300.0	50.0	131	1175.00	27.00	29.84
42499	HAWKINS WOODBINE	6	EAST TEXAS	WOODBINE	SS	COMBINED	4500.0	109.0	300	3394.00	24.00	814.21
42315	HAYNES MITCHELL	6	EAST TEXAS	MITCHELL	LS	SG	5900.0	18.0	140	25.00	40.00	13.42
42423	HITTS LAKE PALUXY	6	EAST TEXAS	PALUXY	SS	SG+WD	7200.0	32.0	130	400.00	26.00	13.61
42067	KILDARE RODESSA	6	EAST TEXAS	RODESSA	LS,SS	SG	6000.0	17.0	60	27.00	40.00	12.99
42001	LONG LAKE WOODBINE	6	EAST TEXAS	WOODBINE	SS	SG+PWD	5200.0	21.0	60	1085.00	40.00	36.49
42499	MANZIEL PALUXY	6	EAST TEXAS	PALUXY	SS	WD	6300.0		165	830.00	32.00	21.93
42499	MERIGALE-PAUL SUB-CL.	6	EAST TEXAS	SUB-CLARKSVILLE	SS	SG	4800.0	0.0	235	300.00	30.00	11.25
42001	NECHES WOODBINE	6	EAST TEXAS	WOODBINE	SS	WD	4700.0	23.0	90	1020.00	40.00	98.84
42459	NEW DIANA WOODBINE	6	EAST TEXAS	WOODBINE	SS	WD	3700.0	11.0	75	141.00	40.00	11.43
42159	NEW HOPE BACON LIME	6	EAST TEXAS	BACON LIME	LS	SG+MWD	7400.0	11.0	120	379.00	44.00	15.45
42159	NEW HOPE PITTSBURG	6	EAST TEXAS	PITTSBURG	SS	SG+MWD	8000.0	14.0	367	61.00	46.00	20.14
42449	PEWITT RANCH PALUXY	6	EAST TEXAS	PALUXY	SS	WD	4300.0	29.0	78	2460.00	19.00	23.38
42063	PITTSBURG PITTSBURG	6	EAST TEXAS	PITTSBURG	SS	SG	8000.0	19.0	107	40.00	42.00	15.13

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42499	QUITMAN EAGLE FORD	6	EAST TEXAS	EAGLE FORD	SS	SG+WD	4200.0	35.0	200	115.00	25.00	10.65
42499	QUITMAN PALUXY	6	EAST TEXAS	PALUXY	SS	WD	6200.0	20.0	150	599.00	43.00	77.65
42067	RODESSA	6	EAST TEXAS	RODESSA	LS,SS	COMBINED	5700.0	20.0	80	61.00	43.00	67.00
42423	SAND FLAT PALUXY	6	EAST TEXAS	PALUXY	SS	SG	7000.0	30.0	251	277.00	29.00	33.24
42423	SHAMBURGER LAKE PALUXY	6	EAST TEXAS	PALUXY	SS	SG	7300.0	28.0	585	200.00	32.00	29.63
42449	TALCO PALUXY	6	EAST TEXAS	PALUXY	SS	WD	4300.0	44.0	200	2000.00	22.00	279.62
42401	EAST TEXAS WOODBINE	6	EAST TEXAS	WOODBINE	SS	WD	3600.0	35.0	324	1300.00	38.00	5041.24
42433	BOYD CONGL.	7B	PERMIAN BASIN	BEND CONGLOMERATE	CONGL	SG+PWD	6000.0	27.0	125	55.00	40.00	25.59
42429	BRECKENRIDGE POOL	7B	BEND ARCH	CADDO LIME	LS	SG	3100.0	35.0	80	15.00	38.00	145.00
42151	CLAYTONVILLE CANYON	7B	PERMIAN BASIN	CANYON	LS	SG+PWD	5700.0	155.0	820	10.00	42.00	63.09
42417	COOK RANCH COOK	7B	BEND ARCH	COOK	SS	SG	1300.0	20.0		380.00	38.00	11.66
42429	CURRY POOL	7B	BEND ARCH	CADDO LIME	LS	SG	3200.0	37.0	90	12.00	40.00	6.00
42429	ELIASVILLE POOL	7B	BEND ARCH	CADDO LIME	LS	SG	3300.0	27.0	90	8.00	39.00	28.00
42433	FLOWERS CANYON SAND	7B	PERMIAN BASIN	CANYON	SS	SG	4100.0	15.0		17.00	41.00	29.10
42253	GRIFFIN	7B	BEND ARCH	PALO PINTO LIME	LS	WD	3300.0	32.0	55		43.00	10.23
42253	HAMLIN EAST	7B	BEND ARCH	SWASTIKA	SS	SG+PWD	3200.0	25.0	55	350.00	39.00	13.99
42433	KATZ	7B	PERMIAN BASIN	STRAWN	SS	WD	4900.0	20.0	74	200.00	37.00	37.60
42433	KATZ 5100	7B	PERMIAN BASIN	STRAWN	SS	WD+SG	5100.0	35.0	90	56.00	37.00	16.92
42353	LAKE TRAMMELL W. CANYON	7B	PERMIAN BASIN	CANYON	SS	SG	5200.0	19.0	180	6.00	40.00	10.68
42353	NENA LUCIA STRAWN REEF	7B	PERMIAN BASIN	STRAWN	LS	SG+GCE	6900.0	52.0	230	5.00	46.00	33.67
42433	OLD GLORY	7B	PERMIAN BASIN	BEND CONGLOMERATE	CO,SS	SG+PWD	5900.0	17.0	120	49.00	40.00	12.51
42133	RANGER	7B	BEND ARCH	RANGER	SS,CO	SG	3400.0	26.0		162.00	37.00	65.78
42151	ROUGH DRAW NOODLE CREEK	7B	PERMIAN BASIN	NOODLE CREEK	LS	SG	3900.0	5.0	140	178.00	42.00	10.44
42151	ROUND TOP PALO PINTO	7B	PERMIAN BASIN	PALO PINTO LIME	LS	SG+WD	4800.0	90.0	475	6.00	40.00	48.68
42207	SOJOURNER	7B	PERMIAN BASIN	STRAWN	SS	SG	5300.0	19.0	115	15.00	41.00	10.14
42461	AMACKER-TIPPETT ELL.	7C	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12100.0	285.0		23.00	53.00	17.59
42383	BARNHART ELLENBURGER	7C	PERMIAN BASIN	ELLENBURGER	DOLO	SG+PWD	9000.0	75.0	397	7.00	47.00	16.17
42461	BENEDUM SPRABERRY	7C	PERMIAN BASIN	SPRABERRY	SS	SG	7600.0	33.0	250	0.50	36.00	23.57
42383	BIG LAKE	7C	PERMIAN BASIN	SAN ANDRES	DOLO	WD	3000.0	30.0	160	20.00	36.00	109.27
42383	BIG LAKE ELLENBURGER	7C	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8300.0		282		42.00	21.17
42383	CALVIN DEAN	7C	PERMIAN BASIN	DEAN	SS	SG	7400.0	35.0		1.00	41.00	40.98
42431	COPE	7C	PERMIAN BASIN	SPRABERRY	SS	SG	5100.0	23.0		24.00	35.00	12.12
42399	CREE-SYKES GARDNER	7C	BEND ARCH	GARDNER	SS	SG	4000.0	19.0		111.00	41.00	15.47
42105	ELKHORN ELLENBURGER	7C	PERMIAN BASIN	ELLENBURGER	DOLO	WD+SG	7200.0	121.0	455	34.00	39.00	11.75

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42105	FARMER	7C	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	2200.0	75.0	70	4.00	30.00	18.38
42399	FORT CHADBOURNE	7C	PERMIAN BASIN	STRAWN	LS	SG+PGCE	5400.0	44.0	240	28.00	45.00	53.25
42451	H-J STRAWN	7C	PERMIAN BASIN	STRAWN	LS	SG+PWD	5500.0	50.0	200	100.00	42.00	23.20
42413	HULLDALE PENN. REEF	7C	PERMIAN BASIN	PENNSYLVANIAN REEF	LS	GCE+PWD	5800.0	39.0	87	43.00	40.00	26.55
42081	I.A.B. MENIELLE PENN.	7C	PERMIAN BASIN	MENIELLE	LS	SG	5800.0	75.0	435	27.00	44.00	21.50
42081	JAMESON	7C	PERMIAN BASIN	CISCO SAND	SS	SG	6300.0	40.0	700	2.00	49.00	44.85
42081	JAMESON REEF	7C	PERMIAN BASIN	STRAWN	LS	GCE+SG	6400.0	71.0	405	2.00	43.00	41.41
42461	MCCAMEY	7C	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DO,SS	SG+PWD	2200.0	75.0	260	18.00	28.00	132.84
42413	NEVA WEST STRAWN	7C	PERMIAN BASIN	STRAWN	LS	GCE	6200.0	80.0	166	8.00	46.00	13.90
42105	OLSON	7C	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	1800.0	40.0	200	28.00	25.00	14.04
42461	PEGASUS ELLENBURGER	7C	PERMIAN BASIN	ELLENBURGER	DOLO	GD	13000.0	28.0	829		53.00	92.32
42461	PEGASUS PENN.	7C	PERMIAN BASIN	PENNSYLVANIAN LIME	LS	SG	10500.0	0.0	567	9.00	44.00	15.44
42461	PEGASUS SPRABERRY	7C	PERMIAN BASIN	SPRABERRY	SS	SG	8300.0	30.0	160	0.10	37.00	13.76
42105	SHANNON SAN ANDRES	7C	PERMIAN BASIN	SAN ANDRES	DOLO	SG	2400.0	35.0	170	24.00	26.00	11.62
42329	SPRABERRY TREND	7C	PERMIAN BASIN	SPRABERRY	SS	SG	6800.0	25.0		0.30	39.00	457.00
42451	SUSAN PEAK	7C	PERMIAN BASIN	STRAWN	LS	WD	4700.0	43.0	113	40.00	37.00	14.64
42105	TODD DEEP CRINOIDAL	7C	PERMIAN BASIN	CRINOIDAL	LS	SG+PWD	5800.0	115.0	450	14.00	41.00	36.47
42105	TODD DEEP ELL.	7C	PERMIAN BASIN	ELLENBURGER	DOLO	WD+SG	6000.0	155.0		5.00	42.00	43.97
42105	VAUGHN	7C	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG+GCE	1500.0	30.0	80	10.00	28.00	12.31
42461	WILSHIRE ELLENBURGER	7C	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12200.0	212.0	616	15.00	53.00	40.86
42105	WORLD	7C	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	WD	2600.0	50.0		8.00	27.00	43.35
42371	ABELL SIL.-MONTOYA	8	PERMIAN BASIN	MONTOYA	DO,CH	SG	5000.0	45.0	272		40.00	12.62
42135	ANDECTOR ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8500.0	410.0	817	300.00	44.00	173.28
42003	ANDREWS	8	PERMIAN BASIN	PENNSYLVANIAN LIME	LS	SG	9200.0	0.0	300	31.00	40.00	14.29
42003	ANDREWS NORTH ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12400.0	135.0		50.00	45.00	28.54
42003	ANDREWS SOUTH DEV.	8	PERMIAN BASIN	DEVONIAN	LS,DO	SG	10900.0			2.00	47.00	10.20
42003	ANDREWS S. WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	9100.0	34.0	200	11.00	40.00	14.23
42003	ANDREWS WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	8600.0	25.0	250	18.00	38.00	20.80
42371	APCO-WARNER ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	4600.0	150.0	300	0.00	40.00	12.32
42495	ARENOSA STRAWN DETRITUS	8	PERMIAN BASIN	STRAWN	CH	SG	8500.0	24.0	600	73.00	38.00	21.12

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42003	BAKKE	8	PERMIAN BASIN	PENNSYLVANIAN LIME	LS	SG	8900.0	23.0	500	13.00	40.00	12.14
42003	BAKKE DEVONIAN	8	PERMIAN BASIN	DEVONIAN	DOLO	WD	10500.0		150	903.00	47.00	16.45
42003	BAKKE ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12400.0	122.0		47.00	43.00	23.71
42003	BAKKE WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	8500.0	35.0	200	38.00	41.00	22.34
42003	BEDFORD DEVONIAN	8	PERMIAN BASIN	DEVONIAN	CH,LS	SG+PWD	8800.0	100.0	540	5.00	41.00	16.26
42317	BREEDLOVE SIL.-DEV.	8	PERMIAN BASIN	SILURO-DEVONIAN	DO,LS	WD	12100.0	45.0	145	50.00	41.00	28.97
42103	C-BAR	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	3500.0	35.0	100	5.00	33.00	18.83
42103	CORDONA LAKE DEV.	8	PERMIAN BASIN	DEVONIAN	LS,CH	SG	5400.0	60.0	235	15.00	40.00	25.93
42135	COWDEN NORTH	8	PERMIAN BASIN	GRAYBURG	DO,SS	SG+GCE	4300.0	125.0	800	7.00	35.00	437.07
42135	COWDEN NORTH DEEP	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	5100.0	40.0	100	7.00	37.00	52.17
42135	COWDEN SOUTH	8	PERMIAN BASIN	GRAYBURG	DOLO	SG	4600.0	56.0	800	3.00	35.00	147.40
42135	COWDEN S. 8790 CANYON	8	PERMIAN BASIN	CANYON LIME	LS	SG+LGCE	8800.0	65.0	300	4.00	40.00	33.88
42103	CROSSETT DEV.	8	PERMIAN BASIN	DEVONIAN	LS,CH	SG	5400.0	88.0	260	6.00	44.00	19.80
42461	CROSSETT SOUTH DEV.	8	PERMIAN BASIN	DEVONIAN	DO,CH	SG	5600.0	80.0	500	3.00	42.00	17.15
42003	DEEP ROCK ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12300.0	146.0		10.00	44.00	14.01
42003	DOLLARHIDE CLEAR FORK	8	PERMIAN BASIN	CLEAR FORK	DOLO	SG	6500.0	40.0	350	10.00	38.00	35.97
42003	DOLLARHIDE DEVONIAN	8	PERMIAN BASIN	DEVONIAN	DO,CH	SG	8000.0	70.0	1000	17.00	40.00	81.25
42003	DOLLARHIDE ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	10000.0	187.0		5.00	41.00	25.69
42003	DOLLARHIDE SILURIAN	8	PERMIAN BASIN	SILURIAN	DO,LS	WD	8500.0	194.0	520	9.00	42.00	38.83
42135	DORA ROBERTS ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	SG+WD	13000.0	212.0		280.00	51.00	50.02
42103	DUNE	8	PERMIAN BASIN	GRAYBURG	DOLO	SG	3300.0	80.0	800	6.00	34.00	176.00
42135	EDWARDS WEST CANYON	8	PERMIAN BASIN	CANYON LIME	LS	SG+LWD	8700.0	80.0	300	5.00	41.00	22.77
42301	EL MAR DELAWARE	8	PERMIAN BASIN	DELAWARE SAND	SS	SG	4500.0	15.0		14.00	41.00	17.84
42003	EMBAR ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	7700.0	195.0	380	40.00	45.00	22.34
42003	EMMA	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4000.0	58.0	183	11.00	33.00	20.09
42003	EMMA ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12300.0	290.0	183	54.00	49.00	53.73
42495	EMPEROR DEEP	8	PERMIAN BASIN	UPPER GUADALUPIAN	SS,DO	SG	2900.0	61.0	350	20.00	33.00	11.18
42371	FORT STOCKTON	8	PERMIAN BASIN	UPPER GUADALUPIAN	SS	SG+LGCE	2800.0	38.0	450	35.00	32.00	30.89
42135	FOSTER	8	PERMIAN BASIN	GRAYBURG	DOLO	SG	4300.0	110.0	800	7.00	35.00	256.88
42003	FUHRMAN-MASCHO	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG+WD	4300.0	72.0	295	5.00	32.00	104.48
42003	FULLERTON	8	PERMIAN BASIN	CLEAR FORK	DO,LS	SG	7000.0		500	3.00	42.00	262.21
42003	FULLERTON 8500 DEV.	8	PERMIAN BASIN	DEVONIAN	DOLO	WD	8500.0	40.0	350	50.00	45.00	46.02
42003	FULLERTON SOUTH ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	10700.0	275.0		77.00	44.00	11.82

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42389	GERALDINE-FORD	8	PERMIAN BASIN	CHERRY CANYON	SS	SG	2600.0	28.0	400	49.00	41.00	21.73
42003	GLASCO DEVONIAN	8	PERMIAN BASIN	DEVONIAN	DOLO	WD	12600.0	67.0	150	200.00	37.00	19.99
42135	GOLDSMITH	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG+GCE	4100.0	48.0	300	12.00	36.00	345.85
42135	GOLDSMITH 5600	8	PERMIAN BASIN	CLEAR FORK	DOLO	SG	5600.0	50.0	400	25.00	38.00	223.85
42135	GOLDSMITH CLEAR FORK	8	PERMIAN BASIN	CLEAR FORK	DO,LS	SG	6100.0	70.0	200	5.00	40.00	73.30
42135	GOLDSMITH DEVONIAN	8	PERMIAN BASIN	DEVONIAN	LS,CH	SG+PWD	8000.0	45.0	150	47.00	40.00	13.93
42135	GOLDSMITH NORTH	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4400.0	35.0	200	2.00	35.00	16.46
42495	HALLEY	8	PERMIAN BASIN	YATES-SEVEN RIVERS	SS,DO	COMBINED	2700.0	45.0	300	20.00	34.00	42.43
42135	HARPER	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	4100.0	50.0	400	2.00	36.00	45.55
42135	HARPER ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DO,LS	SG+WD	12300.0	225.0		2.00	46.00	22.46
42135	HEADLEE ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	SG+PWD	13300.0	325.0	393	40.00	51.00	37.68
42495	HENDERSON	8	PERMIAN BASIN	UPPER GUADALUPIAN	DO,SS	SG+LWD	3100.0	40.0	200	50.00	31.00	15.88
42495	HENDRICK	8	PERMIAN BASIN	UPPER GUADALUPIAN REEF	SS,DO	WD	2500.0	100.0	750	7.00	28.00	260.45
42227	HOWARD-GLASSCOCK GLOR.	8	PERMIAN BASIN	GLORIETA	LS,DO	SG+WD	3200.0	60.0		4.00	27.00	87.20
42227	HOWARD-GLASSCOCK PERM.	8	PERMIAN BASIN	PERMIAN LIME	DO,SS	SG	1500.0	147.0		25.00	32.00	310.64
42003	HUTEX DEVONIAN	8	PERMIAN BASIN	DEVONIAN	DO,LS	WD	12500.0	60.0	270	44.00	44.00	44.31
42227	IATAN-EAST HOWARD	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DO,SS	SG+PWD	2700.0	65.0	500	10.00	30.00	143.08
42003	INEZ ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12500.0	50.0		9.00	50.00	16.40
42135	JOHNSON	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DO,LS	SG	4100.0		200	5.00	35.00	29.96
42103	JORDAN	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	3500.0		300	20.00	35.00	84.62
42135	JORDAN ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8800.0			300.00	45.00	31.11
42495	KERMIT	8	PERMIAN BASIN	UPPER GUADALUPIAN	SS,DO	SG	2800.0	22.0	600	14.00	34.00	107.91
42495	KEYSTONE COLBY	8	PERMIAN BASIN	COLBY	SS,DO	SG	3100.0	900.0	550	3.00	38.00	71.70
42495	KEYSTONE DEV.	8	PERMIAN BASIN	DEVONIAN	CH,LS	SG+PGCE	7900.0	60.0	1100	8.00	37.00	15.34
42495	KEYSTONE ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD+PGCE	9600.0	300.0	585	5.00	44.00	144.90
42495	KEYSTONE HOLT	8	PERMIAN BASIN	SAN ANDRES	DO,LS	SG	4800.0	55.0	55	58.00	40.00	39.70
42495	KEYSTONE SIL.	8	PERMIAN BASIN	SILURIAN LIME	DO,LS	SG	8400.0	113.0	1200	3.00	39.00	28.88
42135	LAWSON	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG+PWD	4300.0	36.0	100	6.00	37.00	15.33
42103	LEA ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8200.0	202.0	430	300.00	43.00	20.11

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42003	LOWE ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	13300.0	120.0		31.00	54.00	11.61
42003	LOWE SILURIAN	8	PERMIAN BASIN	SILURIAN	DOLO	SG	12800.0	50.0	150	7.00	49.00	14.41
42227	LUTHER S.E. SIL.-DEV.	8	PERMIAN BASIN	SILURO-DEVONIAN	DOLO	SG	9900.0	65.0	125	16.00	44.00	23.89
42003	MABEE	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4700.0	40.0	150	8.00	32.00	89.56
42003	MABEE	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4700.0	40.0	150	8.00	32.00	89.56
42003	MAGUTEX DEVONIAN	8	PERMIAN BASIN	DEVONIAN	DO,LS	WD	12500.0		150	83.00	43.00	45.43
42003	MAGUTEX ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	LS,DO	WD	13800.0	70.0	160	16.00	46.00	17.23
42003	MARTIN ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8800.0	278.0	545	369.00	43.00	36.40
42103	MCELROY	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	2900.0	86.0	1400	50.00	32.00	483.43
42003	MCFARLAND	8	PERMIAN BASIN	QUEEN	SS,DO	SG	4800.0	17.0	325	12.00	34.00	38.60
42003	MEANS 1	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DO,SS	WD+GCE	4400.0	135.0	230	20.00	31.00	180.36
42003	MEANS 2	8	PERMIAN BASIN	QUEEN	SS	SG	4100.0	7.0	250	40.00	33.00	37.56
42003	MIDLAND FARMS	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG+PWD	4800.0	100.0	250	61.00	32.00	144.62
42003	MIDLAND FARMS ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12600.0		525	9.00	48.00	50.01
42003	MIDLAND FARMS NORTH	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG+PWD	4800.0	51.0	200	6.00	29.00	15.68
42003	MIDLAND FARMS WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	8400.0	20.0	300	30.00	41.00	13.65
42003	NOLLEY WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS,DO	SG+PWD	9100.0	60.0	400	20.00	37.00	26.84
42227	OCEANIC	8	PERMIAN BASIN	PENNSYLVANIAN REEF	LS	WD	8100.0	60.0	215	84.00	42.00	22.71
42371	PAYTON	8	PERMIAN BASIN	YATES	SS	SG	2000.0	20.0		35.00	36.00	13.00
42371	PECOS VALLEY HI GRAV.	8	PERMIAN BASIN	YATES	SS	SG	1700.0	16.0	400	45.00	31.00	19.05
42135	PENWELL	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	3600.0		400	3.00	33.00	83.23
42135	PENWELL ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8900.0	85.0			43.00	13.91
42103	RUNNING W WADDELL	8	PERMIAN BASIN	WADDELL	SS	SG+GCE	6100.0	22.0	350	164.00	38.00	23.73
42103	SAND HILLS MCKNIGHT	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG+GCE	3500.0	150.0	500	1.00	33.00	115.40
42103	SAND HILLS ORD.	8	PERMIAN BASIN	ORDOVICIAN	DOLO	WD	5900.0	20.0	30	0.00	37.00	12.66
42103	SAND HILLS TUBB	8	PERMIAN BASIN	TUBB	DOLO	SG+PGCE	4500.0	47.0	250	30.00	35.00	90.41
42495	SCARBOROUGH	8	PERMIAN BASIN	YATES	SS	SG+LWD	3000.0	55.0	450	12.00	37.00	36.68
42003	SHAFTER LAKE DEV.	8	PERMIAN BASIN	DEVONIAN	LS	SG+PGD	9500.0	140.0	710	6.00	38.00	24.48
42003	SHAFTER LAKE SAN AND.	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4400.0	37.0	400	5.00	34.00	42.80
42003	SHAFTER LAKE WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	8400.0	18.0	235	28.00	42.00	12.16
42475	SHIPLEY	8	PERMIAN BASIN	QUEEN	SS,DO	SG+PWD	2400.0	0.0	150	22.00	35.00	28.44

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42227	SNYDER	8	PERMIAN BASIN	SAN ANGELO	DOLO	SG	2600.0	50.0		1.00	30.00	38.73
42371	TAYLOR-LINK	8	PERMIAN BASIN	SAN ANDRES	SS,LS	SG+WD	1300.0	35.0	90	40.00	32.00	15.30
42003	THREE BAR DEV.	8	PERMIAN BASIN	DEVONIAN	CH,LS	SG	8400.0		375	54.00	40.00	39.04
42371	TOBORG CRETACEOUS	8	PERMIAN BASIN	CRETACEOUS	SS	SG	500.0			86.00	22.00	41.23
42003	TRIPLE-N PENN.	8	PERMIAN BASIN	UPPER PENNSYLVANIAN LIME	LS	SG	8900.0		300	7.00	40.00	15.43
42389	TUNSTILL	8	PERMIAN BASIN	DELAWARE SAND	SS	SG	3300.0	12.0	215	30.00	40.00	11.51
42301	TWOFREDS DELAWARE	8	PERMIAN BASIN	DELAWARE SAND	SS	SG	4900.0	21.0	210	33.00	35.00	12.72
42135	TXL DEV.	8	PERMIAN BASIN	DEVONIAN	CH	SG	8000.0		600	100.00	40.00	43.51
42135	TXL ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	9600.0	240.0	660	39.00	44.00	128.30
42135	TXL TUBB	8	PERMIAN BASIN	CLEAR FORK	DOLO	SG	6200.0		450	1.00	35.00	43.04
42003	UNION	8	PERMIAN BASIN	LOWER CLEAR FORK	DOLO	SG	6900.0	55.0	200	2.00	33.00	15.90
42103	UNIV. BLOCK 31 DEVONIAN	8	PERMIAN BASIN	DEVONIAN	LS,CH	SG	8500.0	130.0	610	0.70	40.00	206.62
42003	UNIV. BLOCK 9 DEV.	8	PERMIAN BASIN	DEVONIAN	DOLO	WD	10500.0	107.0	400	3.00	45.00	20.07
42003	UNIV. BLOCK 9 PENN.	8	PERMIAN BASIN	PENNSYLVANIAN LIME	LS	SG	9000.0	35.0	250	11.00	40.00	12.66
42003	UNIV. BLOCK 9 WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	8400.0	40.0	250	14.00	38.00	25.62
42103	UNIV. WADDELL DEV.	8	PERMIAN BASIN	DEVONIAN	LS,CH	SG	8600.0		900	1.00	40.00	61.07
42227	VEALMOOR	8	PERMIAN BASIN	CANYON REEF	LS	WD	7800.0	95.0	200	32.00	46.00	37.52
42033	VEALMOOR EAST	8	PERMIAN BASIN	CANYON REEF	LS	WD	7400.0	107.0	610	38.00	48.00	59.98
42329	VIREY ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	SG+WD	13100.0	153.0	0	32.00	51.00	30.08
42103	WADDELL	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	3500.0	100.0	300	12.00	34.00	99.33
42475	WARD SOUTH	8	PERMIAN BASIN	UPPER GUADALUPIAN	SS,DO	SG	2400.0	18.0	350	40.00	35.00	104.13
42475	WARD-ESTES NORTH	8	PERMIAN BASIN	UPPER GUADALUPIAN	SS,DO	COMBINED	2500.0	30.0	600	40.00	38.00	366.69
42329	WAR-SAN ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	SG+PWD	13100.0	150.0		51.00	49.00	14.27
42335	WESTBROOK	8	PERMIAN BASIN	CLEAR FORK	DOLO	SG	2900.0	45.0	250	5.00	24.00	90.74
42301	WHEAT	8	PERMIAN BASIN	DELAWARE SAND	SS	SG	4300.0	17.0	230	19.00	36.00	21.80
42495	WHEELER ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	10500.0	88.0	342	54.00	44.00	17.85
42135	YAR. AND ALLEN ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	10500.0	24.0		28.00	41.00	40.13
42371	YATES PERM. GUAD.	8	PERMIAN BASIN	PERMIAN GUADALUPIAN	DO,LS	GD+GCE	1250.0	120.0	486	118.00	30.00	1180.07
42317	ACKERLY DEAN	8A	PERMIAN BASIN	DEAN	SS	SG	8200.0	35.0	500	0.40	38.00	33.35
42445	ADAIR	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4800.0	60.0	140	4.00	34.00	56.61

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42445	ADAIR WOLFCAMP	8A	PERMIAN BASIN	WOLFCAMP	LS	SG	8500.0	68.0	215	28.00	43.00	51.48
42165	AMROW DEVONIAN	8A	PERMIAN BASIN	DEVONIAN	DOLO	WD	12600.0	131.0	159	34.00	35.00	14.89
42279	ANTON-IRISH	8A	PERMIAN BASIN	CLEAR FORK	DOLO	SG	5300.0	141.0	700	9.00	31.00	175.24
42501	BRAHANEY	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	5200.0	35.0	179	2.00	32.00	43.00
42501	BRONCO SIL.-DEV.	8A	PERMIAN BASIN	SILURO-DEVONIAN	DOLO	WD	11800.0	160.0	265	150.00	44.00	13.97
42165	CEDAR LAKE	8A	PERMIAN BASIN	SAN ANDRES	DO,LS	SG	4800.0	50.0	250	12.00	33.00	78.60
42263	CLAIREMONT	8A	PERMIAN BASIN	LOWER PENNSYLVANIAN	LS	WD	6700.0	20.0	47	21.00	39.00	15.27
42263	COGDELL	8A	PERMIAN BASIN	CANYON REEF	LS	SG	6800.0	73.0	770	18.00	42.00	256.48
42415	DIAMOND M	8A	PERMIAN BASIN	CANYON REEF	LS	SG+PWD	6600.0	80.0	440	72.00	44.00	237.59
42169	DORWARD	8A	PERMIAN BASIN	SAN ANGELO	DOLO	SG	2400.0	45.0	100	3.00	38.00	18.25
42165	FLANAGAN U. CLFK.	8A	PERMIAN BASIN	UPPER CLEAR FORK	DOLO	SG	6300.0	45.0	750	3.00	32.00	20.85
42415	FLUVANNA STRAWN	8A	PERMIAN BASIN	STRAWN	LS	SG+PWD	7800.0	42.0	300	93.00	40.00	13.63
42169	GARZA	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	2500.0	55.0	300	8.00	35.00	95.01
42033	GOOD	8A	PERMIAN BASIN	CANYON REEF	LS	WD	8000.0	246.0	489	52.00	44.00	47.11
42165	HARRIS	8A	GULF COAST BASIN	GLORIETA	DO,SS	SG	5900.0	55.0		11.00	31.00	61.46
42033	HOBO	8A	PERMIAN BASIN	CISCO REEF	LS	WD	7100.0	39.0	100	32.00	46.00	12.17
42033	JO-MILL SPRABERRY	8A	PERMIAN BASIN	SPRABERRY	SS	SG	7100.0	19.4		3.00	39.00	81.94
42415	KELLY-SNYDER	8A	PERMIAN BASIN	CANYON REEF	LS	SG	6700.0	137.0	700	19.00	42.00	1210.99
42415	KELLY-SNYDER CISCO SAND	8A	PERMIAN BASIN	CISCO SAND	SS	SG	6100.0	20.0	120	42.00	42.00	15.18
42445	KINGDOM ABO	8A	PERMIAN BASIN	ABO	DOLO	SG	7800.0	70.0	400	5.00	30.00	42.12
42079	LEVELLAND	8A	PERMIAN BASIN	SAN ANDRES	DO,LS	SG	4900.0	50.0		2.00	30.00	493.32
42501	OWNBY	8A	PERMIAN BASIN	UPPER CLEAR FORK	DOLO	SG	6900.0	47.0	165	4.00	31.00	15.89
42501	PRENTICE	8A	PERMIAN BASIN	GLORIETA	DOLO	SG	6000.0	52.0	180	12.00	28.00	47.55
42501	PRENTICE 6700	8A	PERMIAN BASIN	UPPER CLEAR FORK	DOLO	SG	6700.0	85.0	270	2.00	28.00	112.39
42501	REEVES	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	5600.0	45.0	180	3.00	32.00	25.60
42033	REINECKE	8A	PERMIAN BASIN	CISCO REEF	LS	SG+PWD	6800.0	65.0	304	22.00	46.00	78.17
42415	REVILO GLORIETA	8A	PERMIAN BASIN	GLORIETA	DOLO	SG	2700.0	28.0		3.00	35.00	12.98
42165	RILEY N. U. CLFK.	8A	PERMIAN BASIN	UPPER CLEAR FORK	DOLO	SG	6300.0	70.0	60	12.00	32.00	26.90
42165	ROBERTSON N. CLFK.	8A	PERMIAN BASIN	CLEAR FORK	DOLO	SG	7100.0	35.0	200	19.00	35.00	122.83
42165	RUSSELL 7000 CLFK.	8A	PERMIAN BASIN	CLEAR FORK	DOLO	SG	7000.0	95.0	700	2.00	35.00	53.57
42165	RUSSELL NORTH DEV.	8A	PERMIAN BASIN	DEVONIAN	DOLO	WD	11200.0	65.0	500	141.00	41.00	77.05
42263	SALT CREEK	8A	PERMIAN BASIN	CANYON REEF	LS	SG	6300.0	100.0	726	10.00	40.00	260.91

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42165	SEMINOLE	8A	PERMIAN BASIN	SAN ANDRES	DOLO	GCE+SG	5200.0	87.0	262	25.00	35.00	458.19
42165	SEMINOLE WEST	8A	PERMIAN BASIN	SAN ANDRES	DOLO	GCE,SG	5100.0	180.0	140	9.00	34.00	31.90
42415	SHARON RIDGE 1700	8A	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	1700.0	35.0		3.00	28.00	55.89
42415	SHARON RIDGE 2400	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	2400.0	95.0	150	8.00	32.00	20.20
42079	SLAUGHTER	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	5000.0	48.0		11.00	30.00	857.50
42263	S-M-S CANYON SAND	8A	PERMIAN BASIN	CANYON	SS	SG	6100.0	17.0	63	117.00	38.00	11.22
42219	SMYER	8A	PERMIAN BASIN	CLEAR FORK	DOLO	SG	5900.0	30.0	200	8.00	26.00	39.45
42115	TEX-HAMON FUSSELMAN	8A	PERMIAN BASIN	FUSSELMAN	DO,CH	WD	11600.0	65.0	167	25.00	40.00	16.21
42033	VON ROEDER AND N.V.R	8A	PERMIAN BASIN	CANYON REEF	LS	SG	6800.0	45.0	155	13.00	43.00	30.04
42501	WASSON	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG+GCE	4900.0	275.0	330	4.00	33.00	1573.83
42501	WASSON 6600 AND 7200	8A	PERMIAN BASIN	CLEAR FORK	DOLO	SG	6900.0	135.0	400	10.00	33.00	107.59
42501	WASSON N.E.	8A	PERMIAN BASIN	LOWER CLEAR FORK	DOLO	SG	7800.0	72.0	400	9.00	30.00	13.72
42115	WELCH	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4900.0	100.0	180	9.00	33.00	141.79
42445	WELLMAN	8A	PERMIAN BASIN	WOLFCAMP REEF	DOLO	SG+PWD	9300.0	338.0	800	100.00	43.00	68.04
42501	WEST DEVONIAN	8A	PERMIAN BASIN	DEVONIAN	DOLO	WD	11100.0	40.0	200	9.00	40.00	22.32
42077	ANTELOPE M1	9	FORT WORTH SYNCLINE	STRAWN	SS	SG+WD	3200.0	18.0	65	133.00	43.00	13.76
42181	BIG MINERAL CRK. BARNES	9	SOUTH OKLAHOMA BASIN	BARNES	SS	SG	5300.0	54.0	300	59.00	37.00	21.08
42237	BRYSON EAST	9	FORT WORTH SYNCLINE	STRAWN	SS	SG	3100.0	20.0		60.00	40.00	14.02
42487	FARGO 3900	9	PALO DURO BASIN (TEXAS 8A)	CANYON	SS	SG	3900.0	22.0	110	100.00	41.00	12.39
42487	FARGO 4200	9	PALO DURO BASIN (TEXAS 8A)	CANYON	SS	SG	4200.0	24.0	215	10.00	40.00	12.70
42097	GATEWOOD	9	PERMIAN BASIN	STRAWN	SS	SG+LWD	1600.0	20.0		148.00	33.00	11.14
42337	HILDRETH	9	FORT WORTH SYNCLINE	BEND	CONGL	SG+PWD	7500.0	15.0	100	257.00	41.00	22.55
42009	HULL-SILK-SIKES 3800	9	BEND ARCH	STRAWN	SS	SG	3800.0	26.0	100	180.00	39.00	20.90
42009	HULL-SILK-SIKES 4300	9	BEND ARCH	STRAWN	SS	SG	4300.0		125	61.00	41.00	50.59
42077	JOY STRAWN	9	FORT WORTH SYNCLINE	STRAWN	SS	SG	4400.0	14.0	150	40.00	41.00	18.40
42485	KMA	9	PALO DURO BASIN (TEXAS 8A)	STRAWN	SS,LS	SG	3700.0	24.0		55.00	40.00	174.27
42275	KNOX CITY NORTH CANYON	9	PERMIAN BASIN	CANYON	LS	SG+PWD	4200.0		155	13.00	40.00	15.25

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42155	RASBERRY 6100	9	PALO DURO BASIN (TEXAS 8A)	CADDO LIME	LS	SG	6100.0	47.0	174	3.00	41.00	12.37
42237	RUSMAG	9	BEND ARCH	CADDO CONGLOMERATE	CONGL	SG+GCE	4600.0	22.0	175	19.00	41.00	15.62
42181	SADLER PENN.	9	SOUTH OKLAHOMA FOLDED BELT	PENNSYLVANIAN	SS	SG	6700.0	25.0	400	28.00	34.00	17.60
42181	SANDUSKY OIL CREEK	9	SOUTH OKLAHOMA FOLDED BELT	SIMPSON	SS	SG+PWD	7200.0	33.0	80	238.00	42.00	14.84
42097	SIVELLS BEND	9	SOUTH OKLAHOMA FOLDED BELT	STRAWN	SS	SG	6600.0	46.0		126.00	42.00	30.35
42097	WALNUT BEND HUDSPETH	9	SOUTH OKLAHOMA BASIN	STRAWN	SS	SG+LWD	3900.0	40.0	100	138.00	40.00	21.50
42097	WALNUT BEND REGULAR	9	SOUTH OKLAHOMA BASIN	STRAWN	SS	SG+WD	4900.0	50.0	300	176.00	36.00	46.34
42097	WALNUT BEND WINGER	9	SOUTH OKLAHOMA BASIN	STRAWN	SS	SG+PWD	5500.0	21.0	300	309.00	32.00	27.74
42237	WORSHAM-STEED BEND	9	FORT WORTH SYNCLINE	BEND CONGLOMERATE	CO,SS	SG+GCE	4700.0	18.0	210	50.00	41.00	10.87

Appendix B

API County Codes

Appendix B

API County Codes

County Code	County	County Code	County
42001	Anderson	42247	Jim Hogg
42003	Andrews	42249	Jim Wells
42007	Aransas	42253	Jones
42009	Archer	42255	Karnes
42013	Atascosa	42263	Kent
42015	Austin	42273	Kleberg
42025	Bee	42275	Knox
42033	Borden	42279	Lamb
42039	Brazoria	42287	Lee
42041	Brazos	42291	Liberty
42055	Caldwell	42293	Limestone
42057	Calhoun	42301	Loving
42063	Camp	42315	Marion
42065	Carson	42317	Martin
42067	Cass	42321	Matagorda
42071	Chambers	42323	Maverick
42077	Clay	42329	Midland
42079	Cochran	42335	Mitchell
42081	Coke	42337	Montague
42097	Cooke	42339	Montgomery
42103	Crane	42349	Navarro
42105	Crockett	42353	Nolan
42115	Dawson	42355	Nueces
42123	Dewitt	42357	Ochiltree
42127	Dimmit	42365	Panola
42131	Duval	42371	Pecos
42133	Eastland	42373	Polk
42135	Ector	42383	Reagan
42151	Fisher	42389	Reeves
42155	Foard	42391	Refugio
42157	Fort Bend	42399	Runnels
42159	Franklin	42401	Rusk
42161	Freestone	42407	San Jacinto
42163	Frio	42409	San Patricio
42165	Gaines	42413	Schleicher
42167	Galveston	42415	Scurry
42169	Garza	42417	Shackelford
42175	Goliad	42423	Smith
42181	Grayson	42427	Starr
42187	Guadalupe	42429	Stephens
42199	Hardin	42431	Sterling
42201	Harris	42433	Stonewall
42207	Haskell	42445	Terry
42219	Hockley	42449	Titus
42223	Hopkins	42451	Tom Green
42227	Howard	42459	Upshur
42237	Jack	42461	Upton
42239	Jackson	42467	Van Zandt
42245	Jefferson	42469	Victoria

County Code	County	County Code	County
42473	Waller	42489	Willacy
42475	Ward	42495	Winkler
42479	Webb	42499	Wood
42481	Wharton	42501	Yoakum
42485	Wichita	42505	Zapata
42487	Wilbarger		

Appendix C

FORTRAN Code Used for Screening

Appendix C

FORTRAN Code Used for Screening

```
$DEBUG
* PROGRAM TO RANK RESERVOIRS FOR CO2 MISCIBLE DISPLACEMENT
      DIMENSION RES(550,13)
      INTEGER I,J,M,N1,K,N2
* "REMEMBER PUT RESERVOIR NUMBER (including optimum)(N1) PLUS ONE IN N2"
      PARAMETER (M = 8, N2 = 377)
      REAL OPTM(M),WRTL(M),WRTR(m),WFAC(m),WORST(m),
     & WT(m,n2),A(n2,m),X(n2,m),SUM3(n2),R(n2),NWELL(N2),
     & W(n2,m),V(n2,n2),TEMP,OPRIC,SPAC,SPACE,NW(N2),
     & COSNW,COSEQP,PIPCAP,COSPIP,SPRC,OPCOS,CO2COS,
     & TOTCOS,NREV,RATRC(n2),SMALL,PERCENT(15),CO2,RF,
     & IRATE, YEAR, BTNPV, PCOST, YREV
      N1=N2-1
      OPEN (5,FILE='INPUTdb.DAT')
      READ (5,*) (OPTM(J),J=1,8)
      READ (5,*) (WRTR(J),J=1,8)
      READ (5,*) (WFAC(J),J=1,8)
      READ (5,*) (PERCENT(J),J=1,15)
      READ (5,*) ((RES(I,J),J=1,13),I=1,N1)
      CLOSE (5)
      OPEN (6,FILE='OUTPUTdb.DAT')
* CALCULATION OF WRTL & WORST FICTICIOUS RESERVOIR
      DO 7 J=1,8
      SMALL=1E20
      DO 8 I=2,N1
      SMALL=MIN(SMALL,RES(I,J))
8     CONTINUE
      WRTL(J)=SMALL
      RES(N2,J)=SMALL
7     CONTINUE
* SELECTION OF WORST PARAMETER
      DO 5,I=1,N2
      DO 10,J=1,8
      IF(RES(I,J) .GT. WRTR(J)) THEN
      RES(I,J)=WRTR(J)
      ELSE
      ENDIF
      IF(RES(I,J) .LE. OPTM(J)) THEN
       WORST(J)=WRTL(J)
```

```
      ELSE
        WORST(J)=WRTR(J)
      ENDIF
* CALCULATION OF NORMALIZED PARAMETER
      TEMP=ABS(WORST(J)-OPTM(J))
      X(I,J)=(ABS(RES(I,J)-OPTM(J))/ABS(WORST(J)-OPTM(J)))
* CALCULATION OF EXPONENTIAL FUNCTION
      A(I,J)=100*EXP(-4.6*(X(I,J)**2))
* CALCULATION OF THE WEIGTHED MATRIX
      W(I,J)=A(I,J)*WFAC(J)
 10   CONTINUE
 5    CONTINUE
* CALCULATION OF THE TRANSPOSED WEIGTHED MATRIX
      DO15,I=1,N2
      DO20,J=1,8
      WT(J,I)=W(I,J)
 20   CONTINUE
 15   CONTINUE
* CALCULATION OF THE PRODUCT MATRIX
      DO25,I=1,N2
      DO30,K=1,N2
      SUM1=0
      DO40,J=1,8
      SUM1=SUM1+W(I,J)*WT(J,K)
 40   CONTINUE
      V(I,K)=SUM1
 30   CONTINUE
 25   CONTINUE
* CALCULATION OF OPTIMUM CHARACTERISTIC PARAMETER
      I=1
      SUM2=0
      DO80,J=1,N2
      SUM2=SUM2+V(I,J)
 80   CONTINUE
      RO=SUM2
* CALCULATION OF THE CHARACTERISTIC PARAMETERS
      DO90,I=1,N2
      SUM3(I)=0
      DO100,J=1,N2
      SUM3(I)=SUM3(I)+V(I,J)
 100  CONTINUE
      R(I)=(100*SUM3(I))/RO
 90   CONTINUE
* END OF TECHNICAL RANKING - BEGINNING ECONOMIC RANKING
      PRINT *,'TECHNICAL SCREENING READY'
      PRINT *,'CONTINUE WITH ECONOMICAL SCREENING? YES=1, NO=0'
```

```
      READ *,EE
      IF (EE.EQ.0) THEN
      PRINT 1010,(R(I),I=1,N2)
      WRITE (6,1010)(R(I),I=1,N2)
      GO TO 120
      ELSE
      CONTINUE
      ENDIF
* ECONOMICAL EVALUATION
 105  PRINT *,'DISCOUNT RATE (fraction)=?'
      READ *,IRATE
      PRINT *,'OIL PRICE ($/Bbl)=?'
      READ *,OPRIC
      PRINT *,'RECOVERY FACTOR (fraction)=?'
      READ *,RF
      PRINT *,'SPACE (acres/well)=?'
      READ *,SPACE
      PRINT *,'CO2 COST ($/MSCF)=?'
      READ *,CO2
* CAPITAL COSTS
* 1.DRILLING
      DO 110,I=2,N1
      IF (RES(I,11).NE.0) SPAC = RES(I,10)/RES(I,11)
      IF (RES(I,11).EQ.0) NW(I)=RES(I,10)/SPACE
      IF (SPAC.LE.SPACE) NW(I)=0
      IF (SPAC.GT.SPACE) NW(I) = (RES(I,10)/SPACE)-RES(I,11)
      IF (RES(I,10).LE.60) NW(I) = 2
      NWELL(I) = NINT(NW(I))
      COSNW=30430*EXP(0.00035*RES(I,12))*NWELL(I)
* 2.EQUIPMENT
      COSEQP=8.3125*RES(I,12)*(RES(I,11)+NWELL(I))
* 3.PIPELINE
      PIPCAP=(RES(I,9)*R(I)*RF/100)*2
      COSPIP=(100000+2008*((PIPCAP)**0.834))*RES(I,13)
* 4.TIME DEPENDENT ECONOMICS
      PCOST = 0
      YEAR = 0
      SUM5 = 0
      DO 125 J=1,15
      YEAR =YEAR+1
* 4.1 YEARLY OIL RECOVERY
      YREC= RES(I,9)*R(I)*1.0E04*PERCENT(J)
* 4.2 CO2 SEPARATION/RECYCLE PLANT
      SPRC=YREC
* 4.3 OPERATION COSTS
      OPCOS=(1040+0.1462*RES(I,12))*12*(RES(I,11)+NWELL(I))
```

```
* 4.4 CO2 PURCHASE COSTS
      CO2COS=YREC*6*CO2
* 4.5 YEARLY GROSS REVENUE
      YREV=(YREC*OPRIC)/((1+IRATE)**YEAR)
* 4.6 NPV OF TIME DEPENDENT COSTS
      SUM4=(CO2COS+SPRC+OPCOS)/((1+IRATE)**YEAR)
* 4.7 BEFORE TAXES NPV OF NET INCOME
      SUM5=YREV+SUM5
      PCOST=PCOST+SUM4
 125  CONTINUE
      BTNPV=SUM5-PCOST
* 5 TOTAL COSTS
      TOTCOS=COSNW+COSEQP+COSPIP+PCOST
* 6 NET REVENUE
      NREV=BTNPV-COSNW-COSEQP-COSPIP
* 7 BENEFIT/COST RATIO
      RATRC(I)=NREV/TOTCOS
 110  CONTINUE
      PRINT 1000,(R(I),RATRC(I),NWELL(I),I=1,N2)
      WRITE (6,1000)(R(I),RATRC(I),NWELL(I),I=1,N2)
      PRINT *,'CHANGE ECONOMICAL PARAMETERS? YES=1, NO=0'
      READ *,EC
      IF (EC.EQ.1) THEN
      GO TO 105
      ELSE
      CONTINUE
      ENDIF
1000  FORMAT (1X,F6.2,2X,F6.3,2X,F4.0)
1010  FORMAT (1X,F6.2)
 120  END
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Ranking of Texas Reservoirs for Application of Carbon Dioxide Miscible Displacement

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